GEOLOGIC COASTAL BLUFF EVALUATION UPDATE
THE COTTAGES AT POINT SAN LUIS
APN: 076-174-009, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

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PROJECT NO. SL03926-7

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1.0 INTRODUCTION

This report presents the results of an update to the Geologic Evaluation of the Coastal Bluff for The Cottages of Point San Luis to be located off of Ana Bay Drive, APN: 076-174-009, in the Avila Beach area of San Luis Obispo County, California. See Figure 1: Site Location Map for the general location of the project area. Figure 1: Site Location Map was obtained from the computer program *Topo USA 8.0* (DeLorme, 2009). The purpose of this evaluation was to determine the geologic coastal bluff hazard on the property and determine the geologic rate of bluff erosion or retreat for a minimum 100-year period.

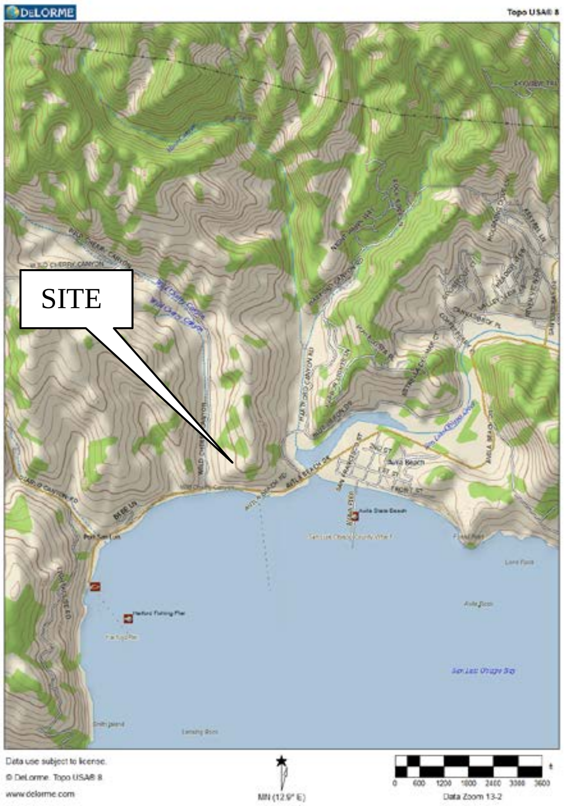

Figure 1: Site Location Map

1.1 Site Description

The Cottages at Point San Luis is located at 35.1797 degrees north latitude and -120.7440 degrees west longitude at a general elevation of 175 to 300 feet above mean sea level. The property is roughly rectangular in shape. Access to the property is provided by a private unpaved access road off of Ana Bay Drive, which is located along the east side of the property. The private unpaved access road leads uphill before branching off towards an existing single-family residence to the east and also north towards Wild Cherry Canyon. The site is located within a Geologic Study Area (GSA) as observed in the referenced Land Use Element Map (County of San Luis Obispo, 1996).

The topography at the Site slopes downward to the south and west. At the existing unpaved access road the slope decreases to near level for approximately 500 feet before sloping steeply downward toward Avila Beach Drive. Surface drainage follows the topography southwest toward Wild Cherry Canyon, which drains into San Luis Bay. There is an existing single family residence currently located on the property, but not in the proposed development area. The proposed building area is currently vacant and covered with annual grasses.

In 2011, removal and re-grading of the bluff was performed by the County of San Luis Obispo due to slope failures from intense storms in 2010. Kane GeoTech, 2011 performed a visual assessment of the slope and resulted in the following conclusions “Approximately 1500-yds^3 of material translated downslope in the two storm events as identified above and formed a debris fan at the base of the slope.” They also identified

"A marginally stable mass estimated to be approximately 2600-yds^3 remain near the top of the slope. The mass is over-steepened and unsupported and will likely fail in the near future." Grading was performed by the County of San Luis Obispo including removal of the marginally stable mass at the top of bluff and constructing a 1:1 buttress fill slope along the base of the slope. Documentation of the work performed was not available at the time of this report. Figure 2 and 3 shows a photograph of the site before and after grading (Adelman, 2002-2015).

1.2 Project Description

It is our understanding that the project will consist of fifty (50) bungalow style cottages and a supporting hospitality building (main lodge) including; a restaurant, spa, banquet rooms, yoga studio, laundry facilities, pool with bar and gift shop. There is an existing single-family residence currently located immediately north of the property, not in the proposed development area. At the time of the preparation of this report, the proposed cottages and hospitality building are to be constructed using light wood framing. Retaining walls are expected to be constructed as part of this project. The project property will hereafter be referred to as the "Site."

Figure 2: Photograph of the Site – 2015 (Adelman, 2002-2015)

Figure 3: Photograph of the Site – 2005 (Adelman, 2002-2015)

2.0 CONCLUSIONS

At the time of our study, it is our understanding that the resort development is proposed in the site area. As no development plans were available, no determination of suitability of proposed building areas are provided. Generally, site development usually contributes to a decrease in top of bluff erosion by decreasing the volume of uncontrolled surface water runoff. General recommendations regarding proposed development are provided and should improve and promote stability of the site and specifically the adjacent coastal bluff. The following conclusions are offered regarding the Site.

2.1 Geologic Conditions

Formational units consisting of the Marine Terrace Deposits (Qt/Qop_2), Squire Member of the Pismo Formation (Tps) and Franciscan Complex pillow basalt (Jfv) were encountered at the property. Plate 1, Site Engineering Geologic Map, depicts geologic conditions at the property. The adjacent bluff extending down to Avila Beach Drive exposes a thin veneer of colluvium overlying very thick sequence marine sedimentary rocks of the Squire Member of the Pismo Formation. Bluff geometry varies from nearly vertical to approximately 1:1 (horizontal:vertical). Surface materials at the property consist of colluvium composed of weathered underlying formational material, alluvium in drainages, and fill along the roadway alignments. Based upon observations during the field investigation, excavation may be by conventional grading equipment although localized hard rock conditions should be expected. The area of the property investigated is currently partially developed with access roadways, however, it is primarily pastureland vegetated with native grasses, bushes, and oak trees.

2.2 Bluff Retreat Rates

A site-specific average current bluff erosion rate of unprotected bluff was calculated where adjacent to the site. It is anticipated that the "estimated foreseeable" erosion rates will continue at this measured rate. The bluff is actively retreating along the bluff face adjacent to the Site and is expected to continue this rate. As a conservative value, the bluff retreat rate is separated into western and eastern portions (separation boundary is located 80 feet west of profile A, see Plates 1 and 3). The retreat rate of 0.36 feet per year was determined for the western portion and 0.59 feet per year for the eastern portion. For a period of 100 years, a retreat of approximately 36 feet for the western portion and 59 feet for the eastern portion may be anticipated (0.36 feet per year x 100 years/0.59 feet per year x 100 years). An additional 23-foot slope stability buffer (see Section 9.1) is added to this 100-year retreat, so an approximate setback for development based upon retreat would be 59 and 82 feet (western portion and eastern portion respectively). Plate 1 through 4 depict the 100-year setback with the additional 23-foot slope stability buffer as measured from the top of bluff. Due to grading of the bluff, the top of bluff has changed along the western portion from the original report. The new top of bluff and setback line are depicted on Plate 1.

2.3 Landslides and Liquefaction

The San Luis Obispo County Safety Element maps the property within a low potential landslide hazard zone (San Luis Obispo County Department of Planning and Building, 1999). Hall, 1973, Dibblee, 2006, and Wiegers, 2011 have not mapped a landslide in the vicinity the Site. Hanson et al., 1994 mapped a landslide along the northwestern boundary of the property near the intersection of the access road and Ana Bay Drive. If future development is proposed near this area, an additional investigation should be prepared in this area to verify the presence and extents of the landslide. No evidence of landslides was observed on photographs in the vicinity of the site.

Previous storm events formed instabilities and debris at the base of the slope along Avila Beach Drive at the Site. In 2011, debris was removed and re-graded forming a buttress fill at the base of the slope. Due to the quality of the rock units, geologic structure of the Squire Member of the Pismo Formation units, and re-grading of the slope, the landslide potential at the Site is considered low with the exception of the vicinity of the existing landslide facing Ana Bay Drive.

The liquefaction potential at the Site is considered low due to the presence of near-surface Pismo Formation materials and the presence of significant clay fraction in the colluvium. The San Luis Obispo County Safety Element identifies the property as being within low potential liquefaction hazard zone (San Luis Obispo County Department of Planning and Building, 1999).

2.4 Faulting and Seismic

The potential for ground rupture at the Site during ground shaking from a fault passing through the site is considered low since no known fault passes through the site. The closest known active Quaternary age fault is the Los Osos fault located approximately 4.5 miles northeast of the Site (Jennings, 2010). The subject site is not located within an Earthquake Fault Zone. Lettis et al., 1994 and Wiegers, 2011 maps the San Luis Bay Fault through the southeast corner of the property. The Site Class for the property is C. The Seismic Design Category for the property is D.

2.5 Tsunami and Flooding

The potential for a tsunami to affect the Site is low due to elevation, approximately 175 to 300 feet above sea level. Flooding associated with a seismic event is generally considered low due to the absence of a body of water upslope of the property.

2.6 Groundwater and Drainage

No free flowing water was observed along the bluff face. The property maintains a southerly and westerly surface gradient toward the top of the bluff. Rill or gully erosion was observed on the bluff face and an erosion gully is located in the central portion of the site. This gully reflected past grading operations that collected water along the on-site driveway, diverting it into the natural gully. This natural gully then concentrated the flow onto a constructed terrace which diverted it to the base of the bluff. Isolated willow trees were noted at several locations at the top of the slope. This indicated short term periods of perched water discharge onto the bluff face from colluvium at the break in slope.

3.0 GEOLOGIC RECOMMENDATIONS

The following are recommended for implementation at the Site.

1. It is recommended that proposed development be setback the combined distance of the 100-year retreat rate with an additional buffer factor of 23-feet as measured from the existing bluff top. This would be a setback of 36 feet for the western portion and 59 feet for the eastern portion plus an additional 23-foot slope stability buffer for a resulting setback would be 59 and 82 feet (western portion and eastern portion respectively). Plate 1 and 3 depict the 100-year setback with the additional 23-foot slope stability buffer as measured from the top of bluff. This setback line should be established in the field as a series of stakes prior to initiation of construction and for layout of all structures.

2. As grading and drainage plans (including but not limited to building size and location, number of stories, intended foundation plans, retaining walls, infrastructure improvements, and landscape improvements) for the development and roadway become available, it is recommended that the engineering geologist conduct a preliminary plan review regarding the locations of proposed improvements and development.

3. A final plan review is recommended to verify that recommendations from subsequent engineering geology reports including the preliminary plan review were implemented.

4. It is recommended that foundations for proposed development (or the keyways and benches of fill slopes) be founded into competent formational units and be in conformance with the project soils report.

5. Building foundation setbacks from slopes are recommended to follow 2013 California Building Code guidelines. Slope stability analysis may provide alternate setbacks

6. It is recommended that concentrated surface water not be allowed to flow uncontrolled over the top of the bluff. Gutters are recommended along eaves of rooflines. Gutter downspouts should not allow concentrated drainage to discharge near the foundations but should be conveyed in solid piping that extends at least to the formational unit platform along Avila Beach Drive or approved alternate. A drainage swale or approved alternate

berm is recommended to be constructed along the top of the bluff and surface drainage should be directed to a drop-inlet(s) that discharges to the formational unit below or approved alternate

7. Rock rip-rap is recommended for concentrated drainage outfall locations that do not discharge onto paved surfaces. It is recommended that geotextile fabric (Enkamat 7010 or similar) be placed underneath the rip-rap and installed per the manufacturer's recommendations.

8. Seepage is anticipated along the interface of the surface colluvial/fill materials and the underlying formational units. Isolated seepage within formational units should also be anticipated. Surface drainage facilities (graded swales, gutters, positive grades, etc) are recommended at the base of cut slopes that allow surfacing water to be transferred away from the base of the slope. The project designer is recommended to offer specific design criteria for mitigation of water drainage behind walls and other areas of the site. This is especially imperative upslope of retaining walls for residences. Subsurface drainage systems should not be connected into conduit from surface drains and should not connect to downspout drainage pipes.

9. At the time of Site development, the Engineering Geologist should periodically observe grading and improvement construction operations to confirm assumptions of this report.

10. Conventional grading equipment may be used for excavations.

11. It is recommended that proposed design of the site improvements be completed by a civil engineer knowledgeable in surface drainage control.

12. Surface drainage should be controlled to prevent concentrated water-flow discharge onto either natural or constructed slopes. Surface drainage gradients should be planned to prevent ponding and promote drainage of surface water away from building foundations, edges of pavements and sidewalks or natural or man-made slopes. For soil areas we recommend that a minimum of two (2) percent gradient be maintained.

13. Excavation, fill, and construction activities should be in accordance with appropriate codes and ordinances of the County of San Luis Obispo. In addition, unusual subsurface conditions encountered during grading such as springs or fill material should be brought to the attention of the Engineering Geologist and Soils Engineer.

14. A final grading report and as-built map is recommended in accordance with County Guidelines for Engineering Geology Reports, Item 29 (San Luis Obispo County Department of Planning and Building, 2013).

4.0 PURPOSE AND SCOPE

The purpose of this investigation was to evaluate engineering geologic hazards at the Site and to develop conclusions and recommendations regarding site development. The scope of this investigation consisted of:

1. Review of historical aerial photographs, pertinent published and unpublished geotechnical studies and literature, and geologic maps for the subject project area.

2. Geologic reconnaissance of the property and adjacent areas on December 16, 2015.

3. Verify the bluff edge, long-term bluff retreat rate based upon aerial photograph interpretation, and setback for slope stability.

4. A review of regional faulting and seismicity hazards.

5. A review of landslide potential, surface and groundwater conditions, and liquefaction hazards.

6. Development of recommendations for site preparation.

7. Preparation of this report that summarizes our findings, conclusions, and recommendations regarding engineering geology aspects of the project.

5.0 ENGINEERING GEOLOGY

5.1 Regional Geology

The Site is located in the vicinity of the San Luis Range of the Coast Range Geomorphic Province of California. The Coast Ranges lie between the Pacific Ocean and the Sacramento-San Joaquin Valley and trend northwesterly along the California Coast for approximately 600 miles between Santa Maria and the Oregon border.

The Site lies within geologic terrain known as the Irish Hills Sub-block of the San Luis/Pismo Structural Block (Lettis and Hall, 1994). The block is bordered on the north by the Los Osos Fault Zone and to the south by the Hosgri Fault Zone. Past tectonic activity along these and other faults in the vicinity have created complex structural and stratigraphic relationships between the various rock units. The principal structural features that account for bedrock and related topography in the area are the Pismo syncline, the Edna fault, the Los Osos fault, San Luis Bay fault and the Hosgri fault.

5.2 Local Geology

Locally, the site is underlain by units of Marine Terrace Deposits, Pismo Formation and Franciscan Complex. Hall, 1973, Hanson et al., 1994, Dibblee, 2006, and Wiegers, 2011 (see Plate 1) have mapped the specific site as Pleistocene age (1.8 million years before present {mybp} to 10,000 years before present) Marine Terrace Deposits (Qt), Upper Pliocene age (3.6-1.8 mybp) Squire Member of the Pismo Formation (Tps) and Jurassic age (206-144 mybp) Franciscan Complex (Jfv) units. Our investigation of the area encountered units of the Marine Terrace Deposits, Pismo Formation and Franciscan Complex. Information derived from subsurface exploration was used to classify subsurface soil and formational units and to supplement geologic mapping.

5.2.1 Surficial Units

Dark brown silty SAND (SM) with clay was observed as surficial deposits along slopes of the property and within borings, which is termed colluvium (Qc). Boring logs exposed approximately 0 to 9 feet of surficial colluvium.

Fill was encountered along Avila Beach Drive and along the dirt access road in the area of the erosion gully. The extent of the fill is mapped on Plate 1. Development is not proposed in the vicinity of fill with the exception of the access road. As no documentation is available from the construction of the roadway it is assumed the fill was not engineered, however the roadway was observed in aerial photographs to be graded prior to 1939 with no evidence of instability. Recommendations can be provided during a plan review of the grading plans.

5.2.2 Formational Units

Formational units were exposed within the bluff face and consist of units of the Pismo Formation. Plate 1, Site Engineering Geology Map, depicts the site as within Marine Terrace Deposits, Pismo Formation and Franciscan Complex. Plates 2A, 2B present cross sections through the site.

Wiegers, 2011 describes the Old Paralic Deposits (Marine Terrace Deposits) (Qop_2) as "Marine terrace deposits consisting of beach and nearshore sands and gravels covered by colluviums and alluvium. These deposits rest on emergent wave-cut platforms preserved by regional uplift. Marine deposits consist of well-sorted sand and gravel locally containing fossils and shell fragments." The Marine Terrace Deposits (Qm) at the site consisted of light gray silty SAND (SM) with gravel encountered in a slightly moist condition. Thickness of the Marine Terrace Deposits is approximately 25 feet (Hall, 1973); and is approximately this thickness as exposed in the cut slope along Avila Beach Drive.

Wiegers, 2011 describes the Squire Member of the Pismo Formation (Tps) as "Massive, white, calcareous, fine- to medium-grained, quartzose to arkosic, silty sandstone. Sand grains subrounded to subangular; 75-80% quartz, 15-20% feldspar, less than 15% mafic minerals (Hall, 1973). Contains lenses of white, well-rounded pebbles and cobbles of Monterey and Obispo Formation clasts north of Edna Fault.Basal conglomerate of rounded chert and basalt cobbles near mouth of San Luis Obispo Creek." The Squire Member of the Pismo Formation (Tps) at the site consisted of pale green sandstone, fine to coarse grained, slightly to moderately weathered (W3-W5), and soft to very soft (H6-H7) to dark gray claystone, fresh to slightly weathered (W1-W3), and soft to moderately soft (H6-H7). Thickness of the Squire Member of the Pismo Formation is approximately 550 feet (Hall, 1973); and approximately 300-feet as indicated on the attached profiles.

Wiegers, 2011 describes the Franciscan Complex (v) as "Chaotic mixture of fragmented rock masses embedded in a penetratively sheared matrix of argillite and crushed metasandstone. Individual rock masses contained in the matrix range from less than a meter to kilometers in scale. Blocks large enough to be shown on map include high grade blueschist (bs), greenstone (mv), pillow basalt (v), greywacke (gw) and chert (ch). Penetrative deformation of matrix postdates metamorphism of enclosed rock masses." Thickness of the Franciscan Rocks is greater than 2000 feet (Hall, 1973); however the thickness at the site is unknown but this is considered the basement unit for this geologic terrain.

Structure	Strike	Dip
Bedding	N15°E	20°W
Bedding	N70°E	22°W

Table 1: Fracture Measurements

Structural attitudes were obtained at the Site within the formational unit. Table 1 lists the attitudes that were obtained at the site. Hall, 1973 and Wiegers, 2011 mapped a structural attitude of N45°E/15°N and N30°E/15°N respectively at the site. Cross section A-A' through G-G' on Plate 2A and 2B presents subsurface interpretations of the area. Based on bedding attitudes at and north of the site it is interpreted that a plunging syncline extends through the site, plunging to the west.

Nine borings were previously drilled for the referenced Preliminary Soils Engineering Report (GeoSolutions, Inc., November 19, 2004) and Soils Engineering Update Report (GeoSolutions, Inc., May 29, 2008) to determine the depth to formational units and determine the quality of the formational material. Plate 1 depicts Squire Member of the Pismo Formation (Tps) throughout the property with colluvial (Qc) cover. Boring logs are presented in Appendix A. Rock and fracture descriptors are within Appendix A.

5.3 Surface and Groundwater Conditions

Surface drainage on the western portion of the property follows the topography west to Wild Cherry Canyon, which drains into San Luis Obispo Bay. The southerly portion of the property follows the topography to the south, except as intercepted by the access roadway, then over the natural bluff to Avila Beach Drive below. The eastern portion of the property follows the topography to the east, except as intercepted by the access roadway, then down the natural slope to Ana Bay Drive below. Rill or gully erosion was observed on the high southerly bluff face and an erosion gully is located in the central portion of the site. Drainage outfall from concentrated drainage should be directed away from the bluff face and toward the existing access road. This gully reflected past grading operations that collected water along the on-site driveway, diverting it into the natural gully. This natural gully then concentrated the flow onto a constructed terrace which diverted it to the base of the bluff. Isolated willow trees were noted at several locations at the top of the slope. This indicated short term periods of perched water discharge onto the bluff face from colluvium at the break in slope. No springs or seeps were observed at the project at the time of our site investigation. It is assumed that for the analyses of this report, static groundwater level is defined by sea level immediately to the south, San Luis Creek to the east, and the bottom of Wild Cherry Canyon to the west. Periods of water perched within the colluvium maybe expected during wet winter periods but not of sufficient duration to substantial accumulate within the underlying formational units.

5.4 Active Faulting and Coseismic Deformation

The Alquist-Priolo Earthquake Fault Zoning Act passed in 1972 requires that the State Geologist establish Earthquake Fault Zones around the surface traces of active faults and to issue appropriate maps. The closest Earthquake Fault Zone is on a section of the Santa Ynez fault located approximately 13.0 miles northwest of the Site. The subject site is not located within an Earthquake Fault Zone (Jennings, 2010).

Table 2: Distance and Moment Magnitude of Closest Faults

Closest Active Faults to Site	Approximate Distance from Site to Active Fault	Moment Magnitude
Los Osos Fault	4.5 miles	7.0
Hosgri Fault	4.5 miles	7.5
San Andreas	43.0 miles	8.0

The closest known active Quaternary age fault is the Los Osos fault located approximately 4.5 miles northeast of the Site. However, the closest known active portion of a Holocene age fault is the active Los Osos fault that is located approximately 6.0 miles northeast of the Site (Jennings, 2010). The San Andreas fault is the most likely active fault to produce ground shaking at the Site although it is not expected to generate the highest ground accelerations because of its distance from the Site. Plate 7 depicts historical epicenters in the vicinity of the site (Toppozada et al., 2000).

5.4.1 San Luis Bay Fault

The San Luis Bay fault is a generally east-west trending reverse fault that displaces and locally warps late Quaternary marine terraces near the community of Avila Beach. It is poorly expressed geomorphically and is observed only in one location near Avila Beach along the west side of the mouth of San Luis Obispo Creek. The fault displaces marine terrace and overlying colluvial deposits. Structural data and sea floor samples suggest that the fault terminates approximately 2-miles southeast of Avila Beach and is not directly continuous with the Wilmar Avenue fault. The long-term slip rate of the San Luis Bay fault varies from 0.02 to 0.11 mm/yr with a recurrence interval of 35,000 years for a M_w6 earthquake (PG&E, 1998). However, the range of slip is comparable to Wilmar Avenue fault activity and suggests a low degree of activity (Lettis, 1990). This fault demonstrates post-late Pliocene displacement. Jennings, 2010 depicts the San Luis Bay fault as showing evidence of displacement during late Quaternary time.

5.4.2 San Miguelito Fault

The San Miguelito fault has been mapped near the property boundaries by several authors (Hall, 1973; Lettis, 1994; Wiegers, 2011). The San Miguelito fault is a 9-km-long, west-northwest-trending zone of branching fault strands that juxtaposes Miocene and Pliocene age volcanic and sedimentary rocks. It is interpreted as a high-angle, generally northeast-dipping fault zone with predominately normal dip-slip displacement (Hall, 1973, Lettis et al., 1994, Wiegers, 2011). The northwestern part of the San Miguelito fault as mapped by Hall is characterized by intense folding and some localized shearing, but no mappable fault traces. Trench investigations conducted by Lettis et al, 1994 correlated stratigraphic displacements across this fault that indicates a significant amount of strike-slip deformation which post-dates the normal deformation.

Faulted upper Pliocene rocks of the Pismo Formation show that movement along the San Miguelito fault has occurred since the late Pliocene. However, trenching studies and detailed bedrock and marine-terrace mapping performed by Lettis et al, 1994 show that the San Miguelito fault is not an active late-Quaternary structure. Detailed mapping of the southern extent of the fault at Mallagh Landing (Pirates Cove Area-Approximately 1 mile to east) provides evidence of no late Quaternary movement along the fault. Other data provide evidence that the San Miguelito fault has had no displacement over the past 120,000 years and probably has had no movement during the late Quaternary (to 700,000 ybp, Lettis et al., 1994). The San Luis Obispo County Safety Element (San Luis Obispo County Department of Planning and Building, 1999) lists the San Miguelito fault as potentially active (movement within the last two million years).

5.5 Landslides

The San Luis Obispo County Safety Element maps the property within a low potential landslide hazard zone (San Luis Obispo County Department of Planning and Building, 1999). Hall, 1973, Dibblee, 2006, and Wiegers, 2011 have not mapped a landslide in the vicinity the Site. Hanson et al., 1994 mapped a landslide along the northwestern boundary of the property near the intersection of the access road and Ana Bay Drive. If future development is proposed near this area, an additional investigation should be prepared in this area to verify the presence and extents of the landslide. No evidence of landslides was observed on photographs in the vicinity of the site.

Previous storm events formed instabilities and debris at the base of the slope along Avila Beach Drive at the Site. In 2011, debris was removed and re-graded forming a buttress fill at the base of the slope. Due to the quality of the rock units, geologic structure of the Squire Member of the Pismo Formation units, and re-grading of the slope, the landslide potential for the proposed development is considered moderate. Proposed development is to be setback from the top of bluff as discussed in Section 8.3 as a mitigation for the landslide potential.

5.6 Flooding and Severe Erosion

The Flood Insurance Rate Map (FEMA, 2012) depicts the base of the bluff to be within the 100-year flood zone. The zone is identified as Zone VE which is the coastal flood zone with velocity hazard (wave action) with a base flood elevation of 20 feet. Based on the Federal Emergency Management Agency Flood Insurance Rate Map there is a low potential for flooding at the Site (FEMA, 2012).

The surficial and formational deposits are subject to erosion where not covered with vegetation or hardscape. The potential for severe erosion is low considered provided that vegetation and erosion control measures are implemented immediately after the completion of grading. Surficial drainage should be prohibited from flowing over the top of bluff to reduce erosion.

5.7 On-site Septic Systems

No septic system is proposed. The project will utilize a community sewer system.

5.8 Hydrocollapse of Alluvial Fan Soils

The potential for hydrocollapse of subsurface materials is considered low due to the absence of alluvial fan material at the Site.

6.0 SEISMOLOGY AND CALCULATION OF EARTHQUAKE GROUND MOTION

6.1 Seismic Hazard Analysis

According to section 1613 of the 2013 CBC (CBSC, 2013), all structures and portions of structures should be designed to resist the effects of seismic loadings caused by earthquake ground motions in accordance with the *Minimum Design Loads for Buildings and Other Structures* (ASCE7) (ASCE, 2010). ASCE7 considers the most severe earthquake ground motion to be the ground motion caused by the Maximum Considered Earthquake (MCE) (ASCE, 2010), which is defined in Section 1613 of the 2013 CBC to be short period S_{MS} and 1-second period S_{M1}, spectral response accelerations.

The a_{max} of the Site depends on several factors, which include the distance of the Site from known active faults, the expected magnitude of the MCE, and the Site soil profile characteristics.

As per section 1613.3.2 of the 2013 CBC (CBSC, 2013), the Site soil profile classification is determined by the average soil properties in the upper 100 feet of the Site profile (ASCE 7). Based on the $(N_1)_{60}$ values calculated for the in-situ tests performed during the field investigation, the Site was defined as Site Class C, Very Dense Soil & Soft Rock profile per ASCE 7 Chapter 20.

According to section 11.2 of ASCE7 and section 1613 of the 2013 CBC (CBSC, 2013), buildings and structures should be specifically proportioned to resist Design Earthquake Ground Motions (Design a_{max}). ASCE7 defines the Design a_{max} as “the earthquake ground motions that are two-thirds of the corresponding MCE ground motions” (ASCE, 2006, p. 109). Therefore, the **Design a_{max} for the Site is equal to S_{D1}=0.423 g and S_{DS}=0.886 g,** which are 1-second period and short period design spectral response accelerations that are equal to two-thirds of the a_{max} or MCE for the Site.

Site coordinates of 35.1797 degrees north latitude and 120.7440 degrees west longitude and a search radius of 100 miles were used in the probabilistic seismic hazard analysis.

6.2 Structural Building Design Parameters

Structural building design parameters within chapter 16 of the 2013 CBC (CBSC, 2013) and sections 11.4.3 and 11.4.4 of ASCE7 are dependent upon several factors, which include site soil profile characteristics and the locations and characteristics of faults near the Site. As described in section 6.1 of this report, the Site soil profile classification was determined to be Site Class C. This Site soil profile classification and the latitude and longitude coordinates for the Site were used to determine the structural building design parameters.

Spectral Response Accelerations and Site Coefficients were obtained from the Seismic Hazard Curves and Uniform Hazard Response Spectra, U.S. Seismic Design Map computer application (USGS, 2013); this program is available from the United States Geological Survey website (USGS, 2013). This computer program utilizes the methods developed in the 2010 ASCE 7 and user-inputted Site latitude and longitude coordinates to calculate seismic design parameters and response spectra (both for period and displacement), for Site Classifications A through E. Analysis of the Design Spectral Response Acceleration Parameters for the Site and of the Occupancy Category for the proposed structure assign to this project a **Seismic Design Category of D** per Tables 1613.3.5(1) and 1613.3.5(2) of the 2013 CBC (CBSC, 2013).

The site specific MCE peak ground acceleration (**PGA_M**) as determined by the USGS computer program (web based) **PGA_M = 0.564 g** which is present on Sheet 5 of 6 of the USGS Design Maps Detailed Report (ASCE 7-10 Standard). See **Appendix C:** USGS Design Maps Summary and Detailed Report.

7.0 LIQUEFACTION

Due to the densities within the sub-surface material and the presence of clays in the subsurface, the liquefaction potential at the Site is considered low.

8.0 COASTAL HAZARDS

8.1 Bluff Erosion and Retreat Processes

Bluff erosion and sea cliff retreat along the central coast of California is generally controlled by a combination of factors including: rock type, geologic structure, soil type, bluff height, direction and magnitude of wave attack, coastline configuration, surf zone profile, amount of surface runoff over bluff tops, degree of water seepage, and other adverse man-made conditions. The effects of erosive agents acting on the bluff are greater on weaker rock types or soils.

The principal causes of sea cliff erosion and retreat along the bluff-top include the forces of natural erosion and weathering of the colluvium and Squire Member of the Pismo Formation and wave attack concentrated at the base of the bluff. Static and Intrinsic sea cliff erosion are on-going active processes that act upon sea cliff bluffs. Static erosion is a process whereby a loss of soil strength is exacerbated through increased pore water within the soil. This is seen as surficial instability and rock falls within a sea cliff. This process is controlled by the availability of surface and subsurface water to the face of the sea cliff.

Marine Terrace Deposits tend to fail by slumping when they become over-weighted by precipitation during winter seasons and when there is no support from underlying sediments. Less significant erosional agents involved in bluff erosion include direct impact of precipitation on the cliff face, runoff down the cliff face, and sapping and winnowing of soils in areas of ground-water seepage.

Bluff erosion at the Site is also based upon the ability of the formational units of the Squire Member and Franciscan Complex to resist wave attack. Storm surge coupled with large wave activity acts to weaken, dislodge, or even remove sections of the formational units or Marine Terrace Deposits. Wave energy, especially winter storm wave activity, exacerbates erosion on the Squire Member of the Pismo Formation. Wave erosion to the bluff has been significantly decreased after improvement to Avila Beach Drive in 1970 due to widening as well as installation of rip-rap to protect the roadway.

Intrinsic erosion is a process of rock and soil weathering due to chemical reaction with available water. This is the process that accounts for loosening, spalling, flaking, granulation, and pulverization of the colluvium and Squire Member due to cycles of wet-dry, alkali-acid, and heat-cold conditions. Intrinsic weathering is the cause of colluvium or formational unit breakdown, resulting in accumulation of slope wash debris along bluff faces.

Other parameters involving erosion include geologic units, bluff geometry, wave action, coastal configuration, surface drainage, and seismicity. The following is a brief discussion of the factors and how they relate to the subject area.

8.1.1 Surficial Drainage

In the current state, surficial drainage is directed toward the bluff top and acts as one of the primary mechanisms for bluff erosion. Accelerated rates of cliff erosion will occur along the bluff top as long as surficial drainage is unchecked. Surface drainage from the top of bluff should be directed to surface drainage inlets via onsite drains and pipes. Development usually reduces the amount of erosion of the colluvium and Squire Member.

8.1.2 Coastal Configuration

The predominant wave direction along the Central California coastline is from the northwest during the spring, summer, and fall months. During the winter months, wave direction can either be from the northwest or southwest, depending upon the source of the current offshore storm. As this area faces south, it would be expected to receive wave action from southern storms. The current configuration of the coastal bluff is located along the south side of Avila Beach Drive. The portion of this major county maintained arterial link to Diablo Canyon Nuclear Power Plant adjacent to the site contains a rip rap coastal protection structure. This serves to mitigate the potential for wave attack at the base of the existing coastal bluff.

8.1.3 Seismicity

The Site, like all other sites in the general area, can be affected by moderate to major earthquakes centered on one of the known large Holocene age active faults listed in Table 2. The maximum moment magnitudes are expressed, although any event on these faults could result in moderate to severe ground shaking at the subject property. Ground shaking can weaken bluff material. Material within the bluff may become dislodged and may tumble due to a seismic event. Due to the long interval between seismic events, the long-term retreat rate would not be substantially affected.

8.2 Bluff Retreat Rates

A bluff retreat rate was determined during the previous Geologic Coastal Bluff Evaluation (GeoSolutions, May 30, 2008). While the top of bluff has been altered during removal of the unstable mass along the bluff performed by the County of San Luis Obispo in 2011 the remainder of the bluff top has not been altered since the original investigation. Therefore the bluff retreat rate is anticipated to be the same as determined in the referenced report however the top of bluff has been relocated due to the previous grading. The original bluff retreat analysis is described below.

The bluff within the study area is actively eroding and is expected to continue to retreat. A historic bluff retreat rate for the Site based upon a reliable aerial photograph evaluation was completed. Our evaluation required site-specific research, with an established rate based upon the actual data interpretation by a Certified Engineering Geologist with experience and knowledge of coastal processes and local bluff conditions.

An aerial photogrammetric investigation was conducted to determine the long-term retreat rate of the bluff in the vicinity of the proposed residence. A residence is apparent north of the subject property in a 1939 aerial image; aerial photography was determined to be the best option to determine bluff erosion through time.

8.3 Aerial Photo Analysis

Aerial photographs dated 1939, 1949, 1956, 1960, 1971, 1989, 1994, and 2002 were reviewed for use in this analysis. The existing residence and oil pier near the site was observed in the aerial photographs. As completed by RRM Design Group of San Luis Obispo, the topographic map was imposed on the aerial photographs aligning the existing residence and oil pier. The historical bluff edge was compared with the present bluff edge to determine the change in bluff location over a defined period in time. This change in location was converted to rate of retreat by dividing the distance of location change by the time period. It is recognized that there is a limit to accuracy involved in the procedure of aligning the images and topographic map. Clarity, exact bluff location, and lack of features add to uncertainty in defining the bluff edge. Limits of accuracy of the interpretation of the bluff edge are recognized with the addition of a buffer (in this case 10 feet) to the bluff retreat rate and conservative (rounding up) values used in calculations.

There appears to have been modifications to the existing bluff through time but the bluff appears to have been unmodified since 1970 Avila Beach Drive roadway improvements. Based on these improvements, a historical retreat rate (pre-1970) and a current retreat rate (post-1970) were determined along various locations of the bluff. Plate 3 depicts the location of the top of bluffs on the topographic map and the bluff retreat locations. Table 5 presents the distance of retreat, time period of retreat, retreat rate and 100-year setback distance.

Figure 4: Photograph of the Site, 1972 (www.californiacoastline.org)

		Distance (ft)	Time (yrs)	Rate (ft/yr)*	100-Year Setback (ft)
Historical	**A**	70.8	29	2.44	244
1939-1968	**B**	47.6	29	1.64	164
	C	33.9	29	1.17	117
	D	19.9	29	0.69	69
	E	37.7	29	1.3	130
	F	75.7	29	2.61	261
	G	78.4	29	2.7	270

* Evidence of modification by man

		Distance (ft)	Time (yrs)	Rate (ft/yr)	100-Year Setback (ft)
Current	**1**	13.4	37	0.36	36
1971-2008	**2**	12.8	37	0.35	35
	3	9.2	37	0.25	25
	4	21.9	37	0.59	59

Table 3: Bluff Erosion Analysis

As a conservative value, the bluff retreat rate is separated into western and eastern portions (separation boundary is located 80 feet west of profile A, see Plate 1 through 3). The retreat rate of 0.36 feet per year is used for the western portion and 0.59 feet per year is used for the eastern portion. For a period of 100 years, a retreat rate of approximately 36 feet for the western portion and 59 feet for the eastern portion may be anticipated (0.36 feet per year x 100 years/0.59 feet per year x 100 years). An additional 23-foot slope stability buffer (see Section 9.1) is added to this 100-year retreat, so an approximate setback for development based upon retreat would be 59 and 82 feet (western portion and eastern portion respectively). Table 4 presents erosion rates for the historic, current, and future periods for the Site.

Table 4: Rate of Bluff Erosion

Time Period	**Rate of Erosion – Western Portion**	**Rate of Erosion – Eastern Portion**
Historic (pre 1970's)	Approximately 0.7 to 2.6 feet per year	Approximately 2.7 feet per year
Current	Approximately 0.36 feet per year	Approximately 0.59 feet per year
Future (development + 100 years*)*	Approximately 0.36 feet per year or less due to control of surface erosion	Approximately 0.36 feet per year or less due to control of surface erosion

According to Johnsson (2003), total development setbacks should include an additional buffer, generally 10 feet, that serves to allow for uncertainty in aspects of the analysis, allows for future increase in bluff retreat due to sea level rise, and assures that at the end of the design life of the structure that the foundation is not being undermined. An additional setback to the 100-year retreat rate would be the greater of either a 10-foot buffer or a slope stability analysis that shows instability greater than 10 feet. The numerical slope stability analysis (as described in Section 9.1) shows that the bluff maintains a factor of safety of 1.5 or greater and that the greater of the two additional setbacks is the 23-foot slope stability analysis. A total setback for the western portion of the bluff is 59 feet, which is the addition of the 100-year retreat rate plus the 23-foot slope stability analysis and the eastern portion of the bluff is 82 feet. This total setback line is depicted on Plate 1, Site Engineering Geology Map and Plate 4, Setback Location.

Table 5: Horizontal Distance from Top of Bluff to Potential Slip Surfaces

Profile	**Static**		**Psuedo-Static**	
	Factor of Safety	**Horizontal Distance***	**Factor of Safety**	**Horizontal Distance***
Profile A	1.86	21 feet	1.45	20.5 feet
Profile B	1.5	13 feet	1.1	15 feet
Profile C	1.5	23 feet	1.1	12 feet
Profile D	1.5	13 feet	1.15	22.5 feet
Profile E	2.5	27 feet	1.78	27 feet
Profile F	2.63	22 feet	1.80	22 feet

*Horizontal Distance refers to the horizontal distance from the top of the bluff to the back of the potential critical slip surface (or that slip surface associated with a minimum static factor of safety of 1.5 or psuedo-static factor of safety of 1.1).

8.4 Tsunami and Seiche

Tsunamis and seiches are two types of water waves that are generated by earthquake events. Tsunamis are broad-wavelength ocean waves and seiches are standing waves within confined bodies of water, typically reservoirs. PG&E, 1988 reported that the historical record for San Luis Obispo County includes no tsunamis that have exceeded the normal tidal range. PG&E, 1988 suggests that faulting on the offshore area could generate tsunami wave height as great as six feet. The Tsunami Inundation Map for Emergency Planning (CAL E.M.A., 2009) maps the tsunami potential along the bluff face southwest of the proposed developement.

The San Luis Obispo County Safety Element states "the worst case scenario would occur if a tsunami occurred during a meteorological high tide (storm surge) which would add an estimated 14.5 feet to the runup values… thus with a worst case scenario, the estimated tsunami runup for the 100-year and 500-year events would be approximately elevation 24 and 39 feet above mean sea level, respectively" (San Luis Obispo County Department of Planning and Building, 1999). However, a latitude specific analysis (Houston and Garcia, 1978) is more accurate for the site when compared to the general tsunami runup elevations presented in the referenced Safety Element for the County of San Luis Obispo (San Luis Obispo County Department of Planning and Building, December 1999). Based on the latitude of the site, the estimated tsunami runup for the 100-year and 500-year events would be approximately elevation 5 and 7 feet above mean sea level. Based on a bluff height of 200 feet elevation, the potential for a 100-year and 500-year seismic water wave event to affect the proposed building area is still considered low. There is a low potential for seismically induced flooding due to the location of the property from a reservoir.

9.0 NUMERICAL SLOPE STABILITY ANALYSIS

9.1 Rotational Numerical Analysis

The bluff located along the southern property line was analyzed to determine whether the existing coastal bluff meets the minimum requirements for slope stability. Six profiles were originally modeled and an additional profile was modeled where the slope configuration as changed utilizing SLOPE/W, a computer-modeling program. The slope stability analysis has been prepared and is presented in Appendix C.

The static analysis resulted in a critical factor of safety (minimum factor of safety) of 1.5. The psuedo-static analysis resulted in a critical factor of safety (minimum factor of safety) of 1.1. In our opinion, the potential slip surface associated with the critical factor of safety would be a surficial failure. It is our opinion that this type of surficial failure would be minimized if over-slope drainage is diverted away from the top of the slope.

The horizontal distance from the top of the bluff to the back of the slip surface for a factor of safety of 1.5 varied from 13 to 23 feet. The horizontal distance for psuedo-static conditions for a factor of safety of 1.1 varied from 12 to 27 feet.

9.2 Planar and Wedge Numerical Analysis

A stereographic analysis was performed for the cut slopes in the proposed enlarge reclamation plan. A representative of GeoSolutions, Inc. performed a site reconnaissance to obtain bedding orientations within the slope. It is understood that bedding data was obtained from surficial outcrop and that continuous fractures were not observed along the slope. Localized areas of highly fractured rock was observed and appeared to be friable and would result in a rotational failure. Using this surficial data, a stereographic analysis was performed to determine the potential for planar and wedge slope failures as per Norrish and Wyllie, 1996. Figure 5 represents the critical zone for slope failure to occur and the orientation of the slope face and fractures.

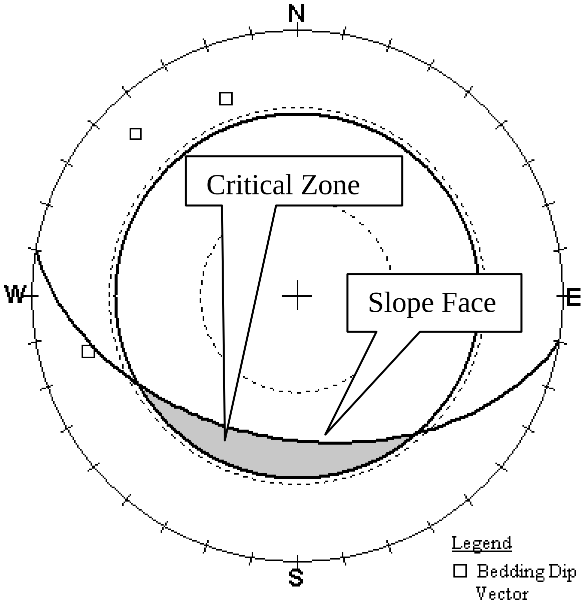

Figure 5: Kinetic Analysis

9.2.1 Planar Failure Analysis

According to Norrish and Wyllie, 1996, the four necessary structural conditions for planar failures are:

1. The dip direction of the fracture must be within 20 degrees of the dip direction of the slope face.
2. The dip of the fracture must be less than the dip of the slope face.
3. The dip of the fracture must be greater than the angle of friction of the surface.
4. The lateral extent of the potential failure mass must be defined by the lateral release surfaces that do not contribute to the stability of the mass.

Based upon the kinetic analysis, the slope bedding within the existing bluff face are not within the critical zone for failure therefore the potential for planar failure is low.

9.2.2 Wedge Failure Analysis

The necessary structural conditions for wedge failures are as follows (Norrish and Wyllie, 1996):

1. The trend of the line of intersection must approximate the dip direction of the face.
2. The plunge of the intersection must be less than the dip of the slope face.
3. The plunge of the line of intersection must be greater than the angle of friction.

Based on the kinetic analysis the slope does not meet the conditions for failure, therefore the potential for wedge failure is low.

Talus slopes are observed on existing cut slopes, indicating raveling of slope material. Due to the hackly fractures of resilient, cemented units within the Pismo Formation there is a high potential for raveling to continue. It is understood that this type of raveling is common, anticipated, and can be periodically graded. Affects of this surficial instability have been assessed as they are included within the Bluff Erosion and Retreat Processes (Section 8.3) for bluff retreat.

10.0 HAZARDS FROM GEOLOGIC MATERIALS

10.1 Expansive Soils

Soils were classified under the Soils Engineering Report (GeoSolutions, Inc., November 19, 2004) as very low to low expansion (expansion index of 6 to 41).

10.2 Naturally Occurring Asbestos

There is a low potential for natural occurring asbestos to be present at the property due to the depth of ultra-basic type rocks that occur within Franciscan Complex units. No proposed site modifications are proposed near the base of the bluff that would disturb underlying basaltic type rock.

10.3 Radon and Other Hazardous Gases

The potential for radon or other hazardous gases is low due to the absence of Monterey Formation formational units and other identified radon producing formations.

11.0 GRADING OPERATIONS, CUT AND FILL, SUBDRAINS

Based on the presence of Squire Member sandstone encountered at the site, conventional grading equipment may be used for excavations. Due to the presence of near surface formational material, it is anticipated that the foundations will be excavated into the formational material. The concurrent Soils Engineering Report provides additional foundation and construction recommendations. Based on the field investigation, subdrains are not anticipated at this time, however this may be reevaluated at the time of construction.

Construction inspections and testing during all grading and excavating operations should be performed by the project Soils Engineer/Engineering Geologist. Section 1705.6A of the 2013 CBC (CBSC, 2013) requires the following inspections by the Soils Engineer/Engineering Geologist as shown in Table 6: Required Verification and Inspections of Soils:

Table 6: Required Verification and Inspections of Soils

Verification and Inspection Task	Continuous During Task Listed	Periodically During Task Listed
1. Verify materials below footings are adequate to achieve the design bearing capacity.	-	X
2. Verify excavations are extended to proper depth and have reached proper material.	-	X
3. Perform classification and testing of controlled fill materials.	-	X
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of controlled fill.	X	-
5. Prior to placement of controlled fill, observe sub-grade and verify that site has been prepared properly.	-	X

12.0 ADDITIONAL SERVICES

The recommendations contained in this report are based on exploratory borings and on the continuity of the sub-surface conditions encountered. It is assumed that GeoSolutions, Inc. will be retained to perform the following services:

1. Consultation during plan development.
2. A preliminary plan review regarding the locations of proposed improvements and development once grading and drainage plans are available.
3. Final plan review of final grading and drainage documents prior to construction.
4. Additionally, construction observation by the Project Engineering Geologist and Soils Engineer may be necessary to verify sub-surface conditions during excavation activities.
5. Final grading report and as-built map in accordance with County Guidelines for Engineering Geology Reports, Item 29 (San Luis Obispo County Department of Planning and Building, 2013).

13.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

The recommendations of this report are based upon the assumption that the soil conditions do not deviate from those disclosed during our study. Should any variations or undesirable conditions be encountered during the development of the Site, GeoSolutions, Inc. will provide supplemental recommendations as dictated by the field conditions.

This report is issued with the understanding that it is the responsibility of the owner or his/her representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project, and incorporated into the project plans and specifications. The owner or his/her representative is responsible to ensure that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field. Information contained within this study must be reevaluated after an engineered site plan has been prepared.

As of the present date, the findings of this report are valid for the property studied. With the passage of time, changes in the conditions of a property can occur whether they are due to natural processes or to the works of man on this or adjacent properties. Therefore, this report should not be relied upon after a period of one year without our review nor should it be used or is it applicable for any properties other than those studied.

Thank you for the opportunity to have been of service in preparing this report. If you have any questions or require additional assistance, please feel free to contact the undersigned at (805) 614-6333.

Sincerely,
GeoSolutions, Inc.

Jeffrey Pfost, CEG 2493
Project Engineering Geologist

JEFFREY PFOST
NO. 2493

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PLATES

Plate 1A, 1B - Site Engineering Geologic Map

Plate 2A, 2B – Cross Sections

Plate 3 – Top of Bluff Map

Plate 4 – Setback Location

Plate 5A, 5B – Regional Geologic Map, Wiegers, 2011 and Geologic Explanations

Plate 6 – Regional Fault Map, Jennings, 2010

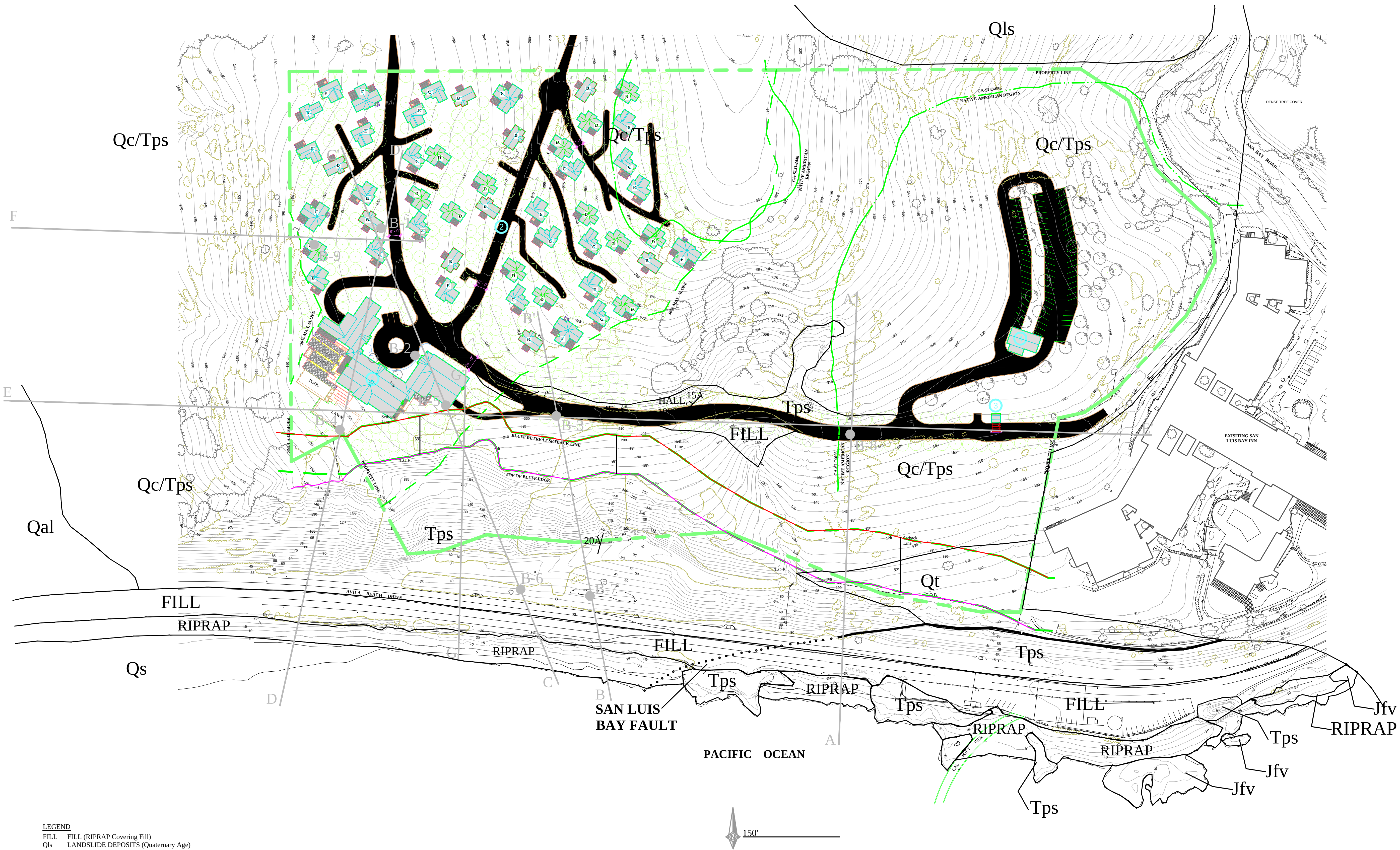
Plate 7 – Historical Seismicity Map

Plate 8 – Aerial Photograph, ASCS-USDA, 1939

Plate 9 – Aerial Photograph, Golden State Aerial Surveys, 2002

Plate 10 – Flood Insurance Rate Map, FEMA, 2012

Plate 11 – Historical Photographs, Best, 1964



LEGEND

FILL	FILL (RIPRAP Covering Fill)
Qls	LANDSLIDE DEPOSITS (Quaternary Age)
Qal	ALLUVIAL DEPOSITS (Quaternary Age)
Qt	MARINE TERRACE DEPOSITS (Quaternary Age)
Tps	SQUIRE MEMBER OF PISMO FORMATION (Pliocene Age)
	Qc/ - Colluvium Cover
Jfv	FRANCISCAN COMPLEX (Cretaceous to Jurassic Age)
—	CONTACT
—	FAULT (San Luis Bay Fault) - Dotted Where Concealed
—	TOP OF BLUFF
—	SETBACK LINE (100-yr Retreat Rate Plus Slope Stability Distance)
20	BEDDING ATTITUDE
	CROSS SECTION

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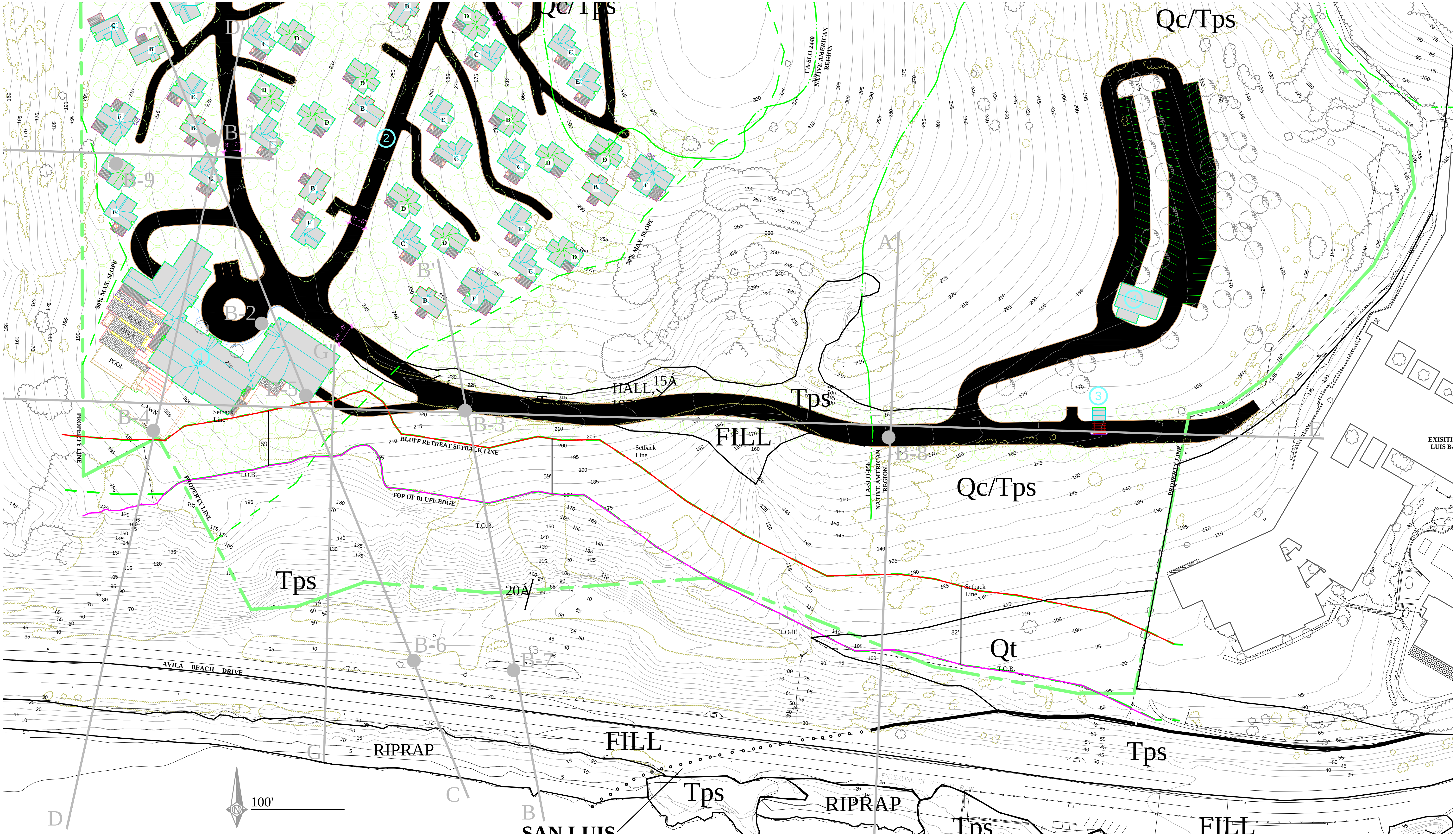
SITE ENGINEERING GEOLOGY MAP
OVERALL SITE
THE COTTAGES AT POINT SAN LUIS, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
1A

PROJECT
SL03926-7



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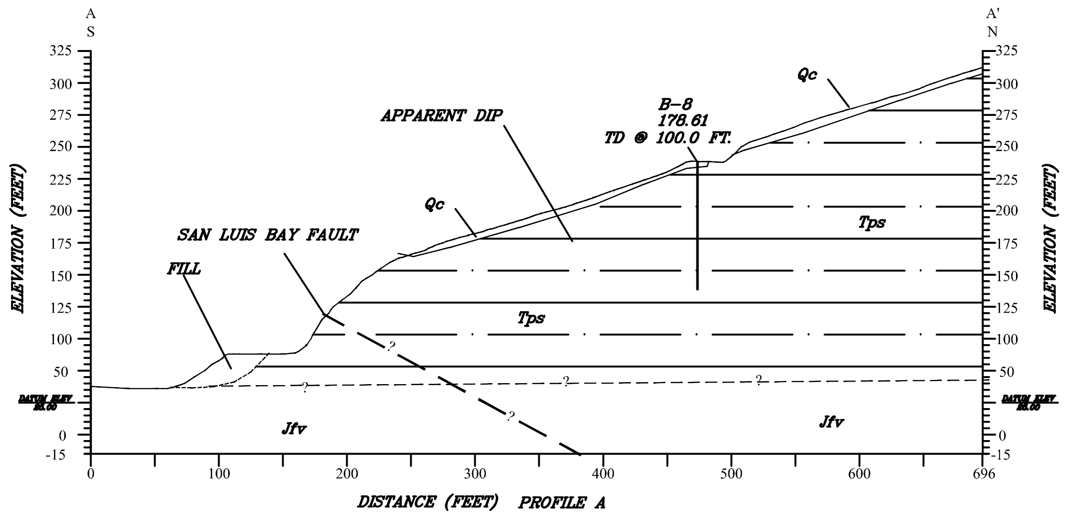
SITE ENGINEERING GEOLOGY MAP
PROPOSED DEVELOPMENT AREA
THE COTTAGES AT POINT SAN LUIS, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

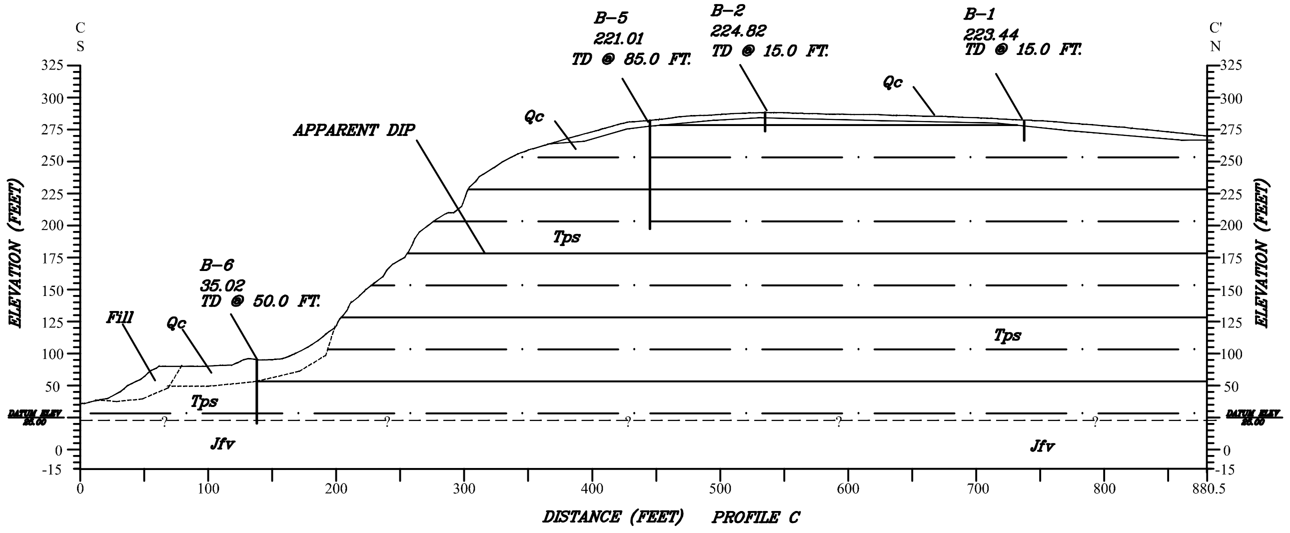
PLATE
1B

PROJECT
SL03926-7

SEE PLATE 1A FOR EXPLANATIONS



PROFILE A



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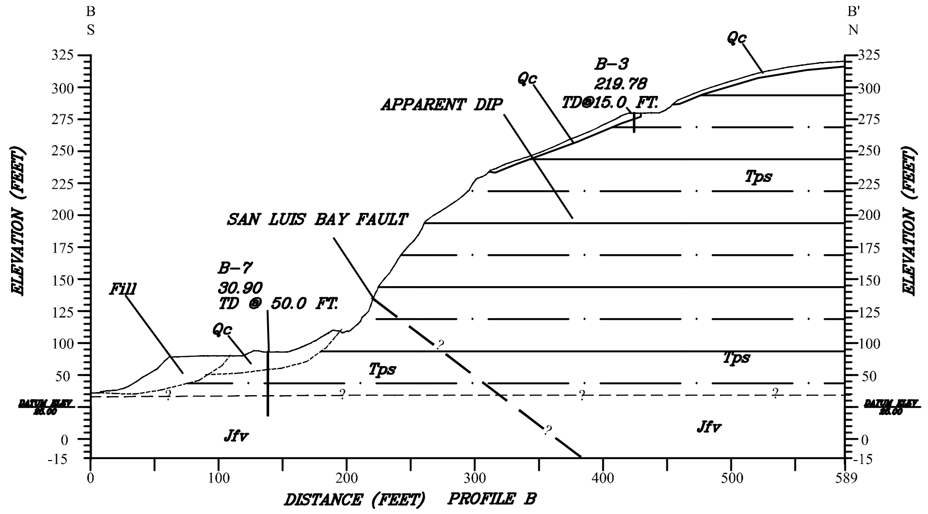
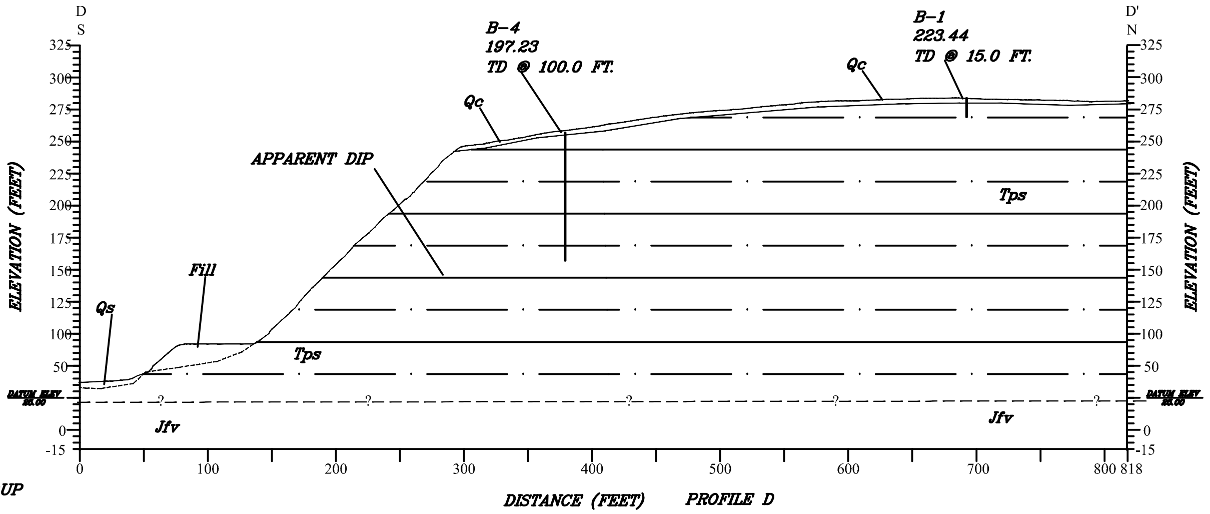


PROFILE B

PROFILES PROVIDED BY RRM DESIGN GROUP



PROFILE D

QUATERNARY

HOLOCENE

FILL	FILL Rip Rap
Qal	Alluvial Deposits
Qc	COLLUVIUM
Qs	BEACH SAND
Qls	LANDSLIDE DEPOSITS

PLEISTOCENE

Qt	TERRACE DEPOSITS

TERITIARY

PLIOCENE

Tps	SQUIRE MEMBER OF THE PISMO FORMATION

JURASSIC

JURASSIC

Jfv	FRANCISCAN COMPLEX

? CONTACT – DASHED WHERE APPROXIMATE, QUERIED WHERE UNKNOWN

? FAULT – DASHED WHERE APPROXIMATE, QUERIED WHERE UNKNOWN, DOTTED WHERE CONCEALED

20° BEDDING ATTITUDE

● BORING LOCATIONS

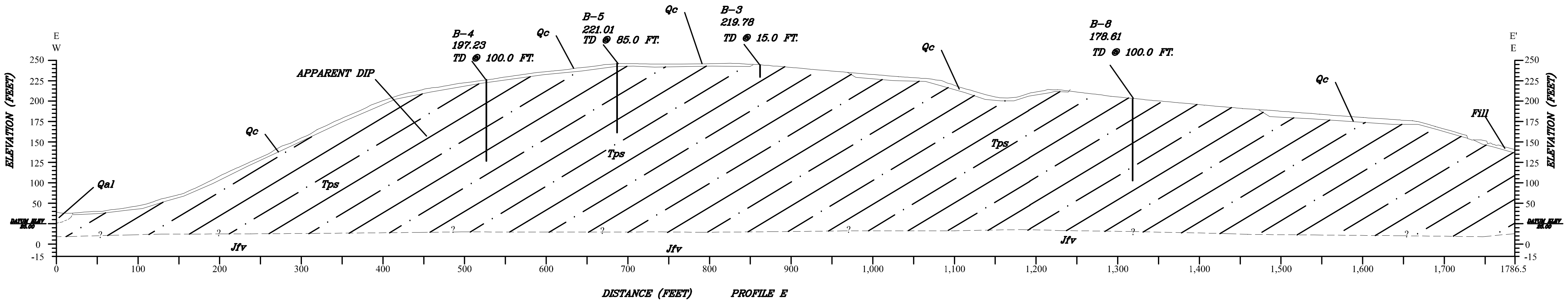
GEOSOLUTIONS
220 High Street
San Luis Obispo, CA 93401
(805) 543-8539 Fax: (805) 543-2171

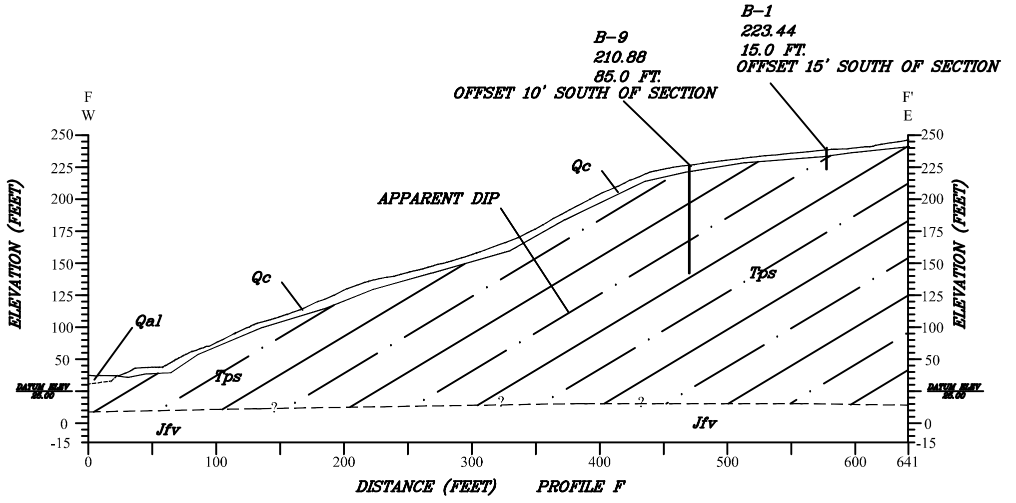
CROSS SECTIONS PROFILES A, B, C AND D

AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
2A

PROJECT
SL03926-7





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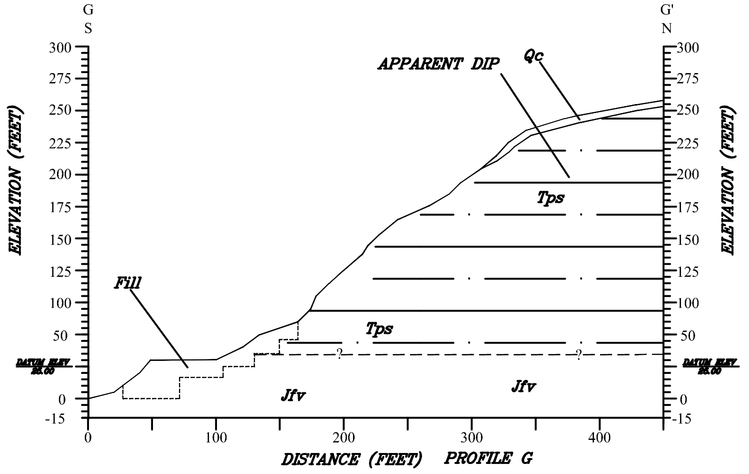

QUATERNARY

HOLOCENE

FILL FILL

Rip Rap

Qal Alluvial Deposits

Qc COLLUVIUM

Qs BEACH SAND

Qls LANDSLIDE DEPOSITS

PLEISTOCENE

Qt TERRACE DEPOSITS

TERITIARY

PLIOCENE

Tps SQUIRE MEMBER OF THE PISMO FORMATION

JURASSIC

JURRASIC

Jfv FRANCISCAN COMPLEX

? CONTACT - DASHED WHERE APPROXIMATE, QUERIED WHERE UNKNOWN

? FAULT - DASHED WHERE APPROXIMATE, QUERIED WHERE UNKNOWN, DOTTED WHERE CONCEALED

20° BEDDING ATTITUDE

● BORING LOCATIONS

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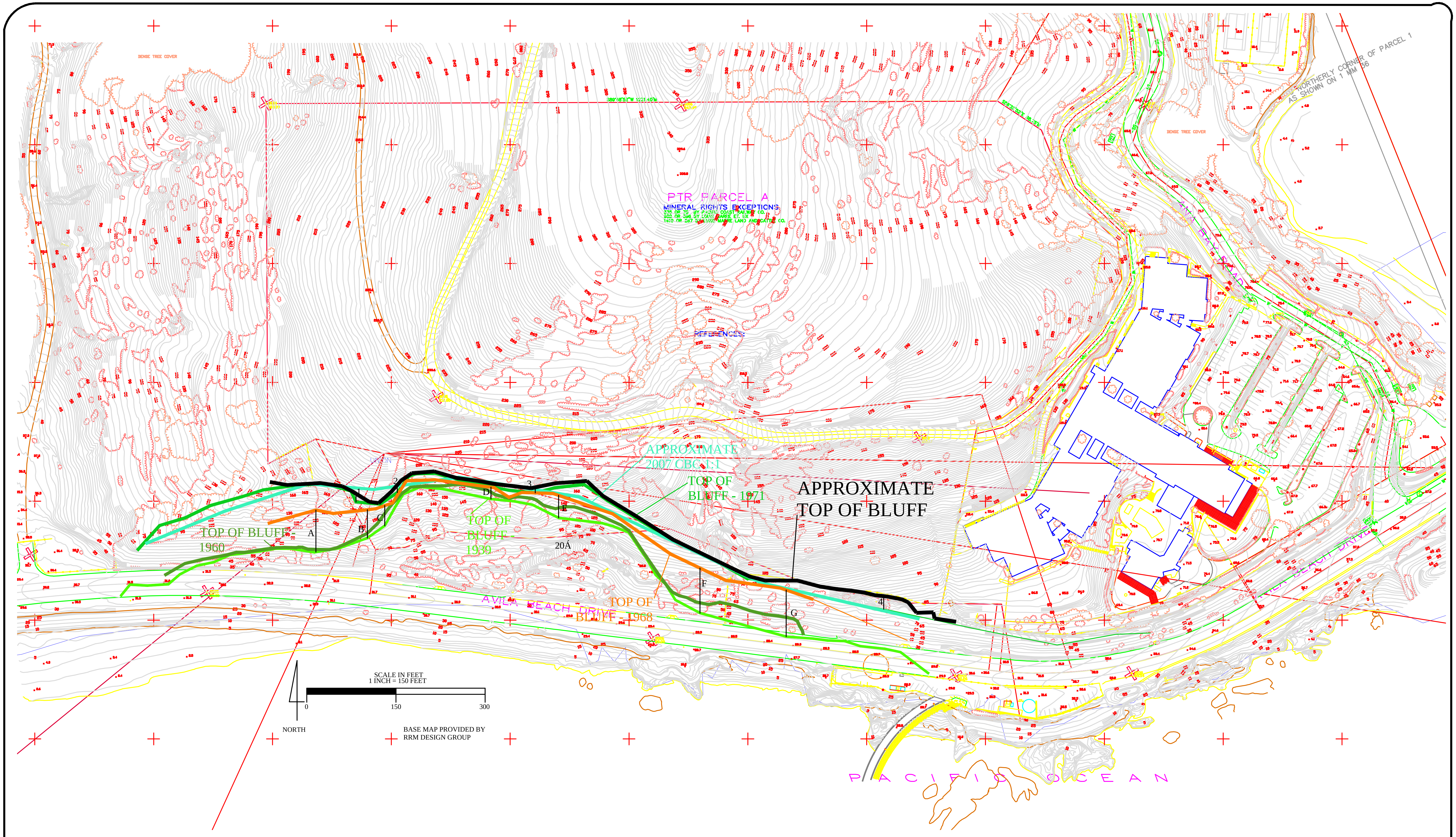
CROSS SECTIONS - PROFILES E, F AND G

AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
2B

PROJECT
SL03926-7



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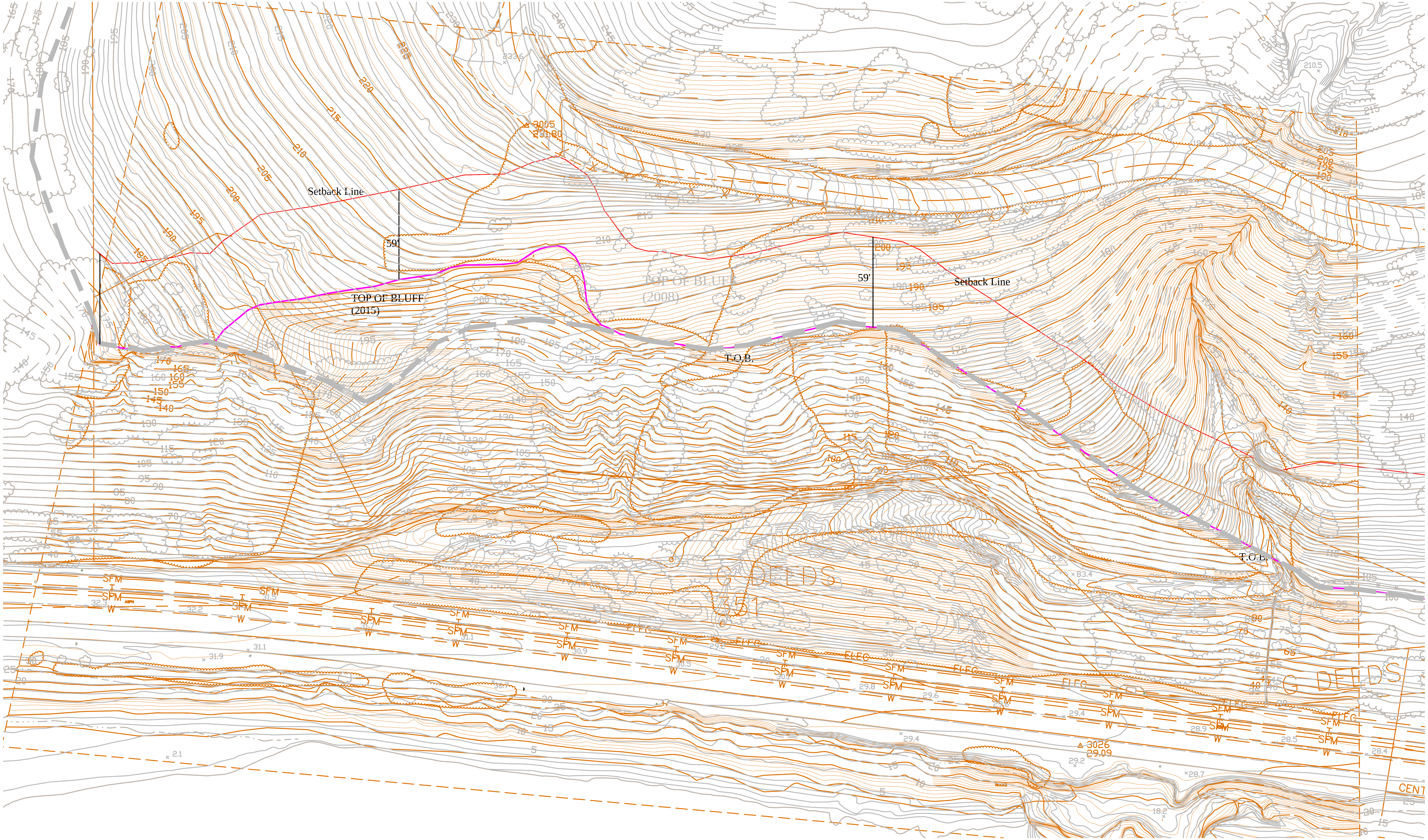
(805) 543-8539 Fax: (805) 543-2171

TOP OF BLUFF MAP

(Original Map)
AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
3

PROJECT
SL03926-7



LEGEND

- TOPOGRAPHY (2008)
- TOPOGRAPHY (2015)
- TOP OF BLUFF (2008)
- TOP OF BLUFF (2015)
- SETBACK LINE (100-yr Retreat Rate Plus Slope Stability Distance)

60'

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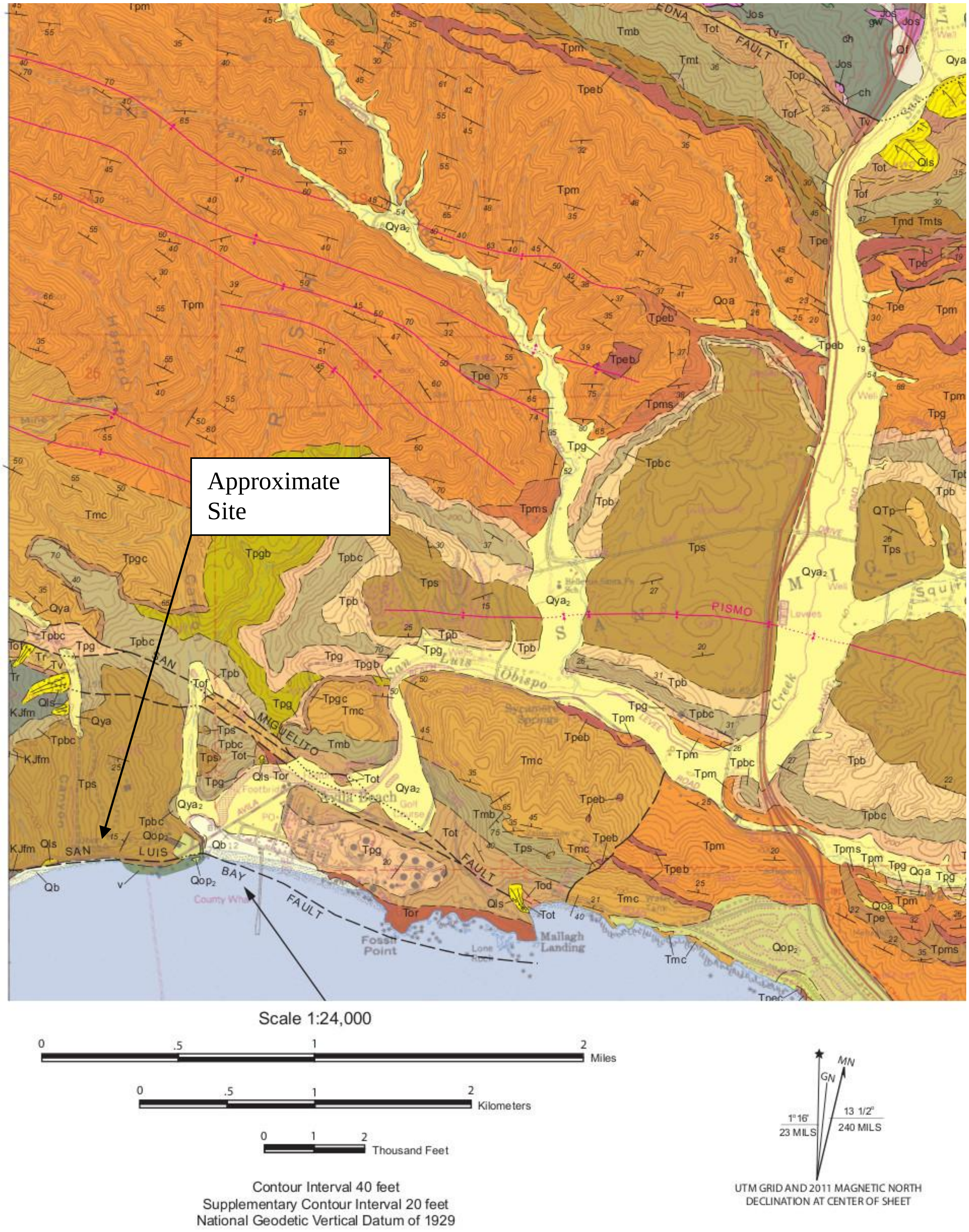
SETBACK LOCATION

AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
4

PROJECT
SL03926-7



SEE PLATE 5B FOR GEOLOGIC EXPLANATIONS

GEOSOLUTIONS
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San Luis Obispo, California 93401
(805) 543-8539 fax: (805) 543-2171

REGIONAL GEOLOGIC MAP

Wiegers, 2011

AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
5A

PROJECT NO:
SL03926-7

DESCRIPTION OF MAP UNITS

QUATERNARY DEPOSITS

Very Young Surficial Deposits

Qa **Alluvial flood-plain deposits (late Holocene)** - Active and recently active flood-plain deposits. Consists of unconsolidated sandy, silty, and clay-bearing alluvium.

Qf **Alluvial fan deposits (late Holocene)** – Small active alluvial fans at the mouths of steep mountain streams. Consists of cobbles, gravel, sand, and silt.

Qb **Beach sand (late Holocene)** – Unconsolidated beach deposits consisting mostly of fine- to medium-grained well-sorted sand.

Qd **Dune sand (late Holocene)** – Unconsolidated, well-sorted white to brown windblown sand. Forms active dunes behind modern beaches.

Qls **Landslide deposits (Holocene)** – Highly fragmented to largely coherent landslide deposits.

Young Surficial Deposits

Qye **Young eolian deposits (Holocene to late Pleistocene)** – Stationary sand dune deposits. Well-sorted white to brown windblown sand.

Qya **Young alluvial valley deposits, undivided (Holocene to late Pleistocene)** – Unconsolidated sand, silt, and clay-bearing alluvium deposited on flood-plains and along valley floors. Locally divided by relative age (2 = youngest, 1 = oldest). Surfaces on young deposits are undissected and lack soil development. Surfaces on older deposits are slightly dissected and display weak soil development.

Qya$_2$ **Young alluvial valley deposits, Unit 2**

Qya$_1$ **Young alluvial valley deposits, Unit 1**

Old Surficial Deposits

Qoa **Old alluvial valley deposits (late to middle Pleistocene)** – Fluvial sediments preserved above active flood plains and channels. These deposits are moderately consolidated, slightly dissected and capped by moderate to well-developed pedogenic soils. Consists of relatively thin deposits of gravel, sand, silt and clay-bearing alluvium overlying eroded bedrock surfaces and older sediments. Forms low rounded topographic rises in San Luis Obispo Valley. Locally perched on isolated strath terraces.

Qop$_{1-3}$ **Old paralic deposits (late to middle Pleistocene)** – Marine terrace deposits consisting of beach and nearshore sands and gravels covered by colluvium and alluvium. These deposits rest on emergent wave-cut platforms preserved by regional uplift. Marine deposits consist of well-sorted sand and gravel locally containing fossils and shell fragments. Overlying non-marine cover consists of poorly-sorted sand, silt, gravel and clay deposited by slope wash and alluvial processes. Divided by relative age (3 = youngest, 1 = oldest). Estimated ages of deposits are as follows (Hanson and others, 1994):

Qop$_3$ **Old paralic deposits, Unit 3 – 80 ka**

Qop$_2$ **Old paralic deposits, Unit 2 – 120 ka**

Qop$_1$ **Old paralic deposits, Unit 1 – 210 ka - 430 ka**

Old Surficial Deposits

Qvoa **Very old alluvial valley and pediment deposits (middle to early Pleistocene)** – Tan silt and fine sand deposited on a gently sloping pediment surface extending down the northeast side of the San Luis Range into San Luis Obispo Valley. Mapped as Paso Robles Formation by Hall (1973). Lacks channel conglomerates. Much of the unit appears gradational with underlying sandstone of the Squire Member of the Pismo Formation (**Tps**) and may in part be residual soil developed on that unit (Nitchman, 1988).

Qvop **Very old paralic deposits (middle to early Pleistocene)** – Marine terrace deposits consisting of beach and near shore sands and gravels covered by colluvium and alluvium. These deposits rest on emergent wave-cut platforms preserved by regional uplift. Well preserved terraces are found about 400 feet above sea level on slopes north and northwest of Pismo Beach. These terraces are estimated to be older than 560 ka (Hanson and others, 1994).

TERTIARY AND OLDER ROCKS

Pismo Formation (lower Pliocene to upper Miocene)

Tps, Tpsc **Squire member** – Massive, white, calcareous, fine- to medium-grained, quartzose to arkosic, silty sandstone. Sand grains subrounded to subangular; 75-80% quartz, 15-20% feldspar, less than 15% mafic minerals (Hall, 1973). Contains lenses of white, well-rounded pebbles and cobbles of Monterey and Obispo Formation clasts north of Edna Fault. Basal conglomerate of rounded chert and basalt cobbles near mouth of San Luis Obispo Creek. Bioturbated with greenish glauconitic sand coatings and clay and silt interbeds in footwall of Wilmar Avenue Fault at Pismo Beach (Nitchman, 1988). **Tpsc** - Conglomerate of rounded chert pebbles near middle of unit on north side of Edna Fault.

Tpbd, Tpb, Tpbc **Belleview member** – Light-gray, bedded, resistant sandstone and interbedded siltstone. Sandstone medium-grained; 60% quartz, 30% feldspar, locally 15% rock fragments (Hall, 1973). **Tpbc** - Interbedded, buff claystone, siltstone and fine-grained sandstone. Claystone speroidally fractured. Sandstone beds locally fossiliferous. **Tpbd** - Well-bedded diatomaceous siltstone, claystone and silty diatomite.

Tpgf, Tpgs, Tpgd, Tpg, Tpgb, Tpgc **Gregg member** – Massive, white, buff-weathering sandstone, soft to resistant, medium-grained; 65% quartz, 30% feldspar, clay 4%, mafic minerals 1% (Hall, 1973). **Tpgs** – Well-bedded sandstone, beds 2 inches to 2 feet thick. **Tpgf** – Massive buff siltstone. **Tpgb** – Locally bituminous sandstone. **Tbgc** – Chert pebble conglomerate. **Tpgd** – Diatomaceous siltstone.

Tpm, Tpms **Miguelito member** – Brown to buff interbedded siltstone and claystone, moderately resistant, well-bedded, beds generally 2 to 4 inches thick. Locally includes beds and lenses of siliceous and dolomitic siltstone and friable, locally bituminous sandstone (Hall, 1973). Opaline and porcelaneous shale is present in the western part of the map area. **Tpms** – Poorly bedded siltstone, diatomaceous siltstone and sandy siltstone. The Miguelito Member consists of basinal mudstones in the west and south parts of the map area that interfinger with coeval inner shelf sandstones of the Edna member to the east.

"

Tpes, Tpet, Tped, Tpe, Tpec, Tpeb **Edna member** – Buff, massive arkosic to quartzose sandstone, fine- to coarse-grained; quartz 80-95%, feldspar less than 5-15% (Hall, 1973). **Tpeb** – Bituminous sandstone zones within Tpe. Oil can be seen leaking from exposures near Price Canyon Oil Field and oily sandstones are exposed on the ridge north of Shell Beach. **Tpec** – Basal conglomerate and/or breccia with clasts ¼-inch to several feet in diameter of Monterey chert, dacite and Franciscan debris. Clasts commonly angular and poorly sorted but locally rounded and well-sorted. Basal conglomerate overlying Monterey Formation well exposed at Shell Beach. **Tpes** – Massive medium- to coarse-grained pebbly sandstone, locally calcareous and fossiliferous. **Tpet** – Hard, buff to gray tuffaceous sandstone, locally siliceous and bituminous. **Tped** – Fine-grained dolomitic sandstone.

Tms, Tmt, Tmc, Tmts, Tmd, Tmb **Monterey Formation (upper to middle Miocene)** – Bedded, resistant chert, color varies from white and gray to brown and reddish-brown, weathering to chalky white. Brittle, conchoidal fracturing, commonly sheared, beds ½ to 6-inches thick, commonly laminated, locally interbedded with diatomite (Hall,1973). **Tmd** – White to buff diatomite with minor tuff, opaline chert and tuffaceous sandstone. **Tmts** – Tuffaceous siltstone, locally interbedded with dolomitic siltstone and opaline chert. **Tmt** – White to blue-gray tuff, very fine- to coarse-grained, locally includes virtic tuff and tuffaceous sandstone. **Tms** – Brown to white siltstone with some claystone. **Tmb** – Tan to yellowish-white siltstone and dolomitic claystone locally tuffaceous or interbedded with chert.

Tod, Tof, Tot, Tor, Top **Obispo Formation (lower Miocene)** – Coarse-grained tuff with subangular clasts of pumice (5%-50%), perlite (5%-15%), white to dark-gray glass shards (20%) and feldspar (5%) in a vitric ashy matrix; commonly altered to montmorillonite (Hall, 1973). Type locality along San Luis Obispo Creek. Locally contains clasts of reddish- brown tuffaceous mudstone. **Top** – Perlite breccia. Patchy white and gray, weathering to dark-gray, contains subangular perlite and pumice clasts 2 to 8 inches in diameter in a tuffaceous matrix. **Tor** – Resistant, hard, fine-grained, zeolized tuff. Forms resistant cliffs at Fossil Point near Avila Beach and resistant outcrops and an ancient sea stack along State Route 1 at Pismo Beach. **Tof** – Yellow to brown tuffacous siltstone and claystone. **Tod** – Diabase dikes and sills. Exposed locally in cliffs at Pismo Beach.

Tr, Trt **Rincon Shale (Oligocene and lower Miocene)** – Dark-brown to orange-brown siltstone and claystone, poorly to well-bedded, weathers white to light-brown. Locally contains yellowish, fine-grained quartzose sandstone. **Trt** – White to buff rhyolitic vitric tuff. Contains quartz and feldspar crystals in a fine-grained ash matrix (Hall, 1973).

Tv **Vaqueros Sandstone (Oligocene)** – Gray to brown, medium- to coarse-grained sandstone and conglomerate, poorly to well-indurated. Conglomerate clasts typically black and green chert. Sandstone grains well-rounded to subrounded with a typical composition of 40% to 60% quartz, 5% to 15% feldspar, 30% to 50% rock fragments (Hall, 1973). Contains fossiliferous zones with broken mollusk shells and large oysters.

mv, gw, KJfm, v, ch, bs **Franciscan Complex mélange (Cretaceous to Jurassic)** – Chaotic mixture of fragmented rock masses embedded in a penetratively sheared matrix of argillite and crushed metasandstone. Individual rock masses contained in the matrix range from less than a meter to kilometers in scale. Blocks large enough to be shown on map include high grade blueschist (**bs**), greenstone (**mv**), pillow basalt (**v**), graywacke (**gw**) and chert (**ch**). Penetrative deformation of matrix postdates metamorphism of enclosed rock masses.

Jos **Serpentinized ultramafic rocks** – Pervasively sheared serpentinite occurring as lenticular fault-bounded bodies in Franciscan mélange. Considered to be dismembered bodies of the Coast Range Ophiolite tectonically interleaved with mélange during subduction. Locally, hydrothermally altered to silica-carbonate rock.

SYMBOL EXPLANATION

Contact between map units - Solid where accurately located, dashed where approximately located, dotted where concealed.

Fault - Solid where accurately located, dashed where approximately located, dotted where concealed. U = upthrown block; D = downthrown block.

Thrust fault - Solid where accurately located, dashed where approximately located, dotted where concealed. Barbs on upper plate.

Synclinal axis - Solid where accurately located, dashed where approximately located, dotted where concealed. Arrow shows plunge direction.

Anticlinal axis - Solid where accurately located, dashed where approximately located, dotted where concealed. Arrow shows plunge direction.

t v ld Aerial photo lineaments (Lettis and Hall, 1994). Dashed where less distinct, queried where questionable. Hachures indicate topographic scarp and direction of slope. t = tonal contrast; v = vegetative lineament; ld = linear drainage.

30 Strike and dip of bedding plane.

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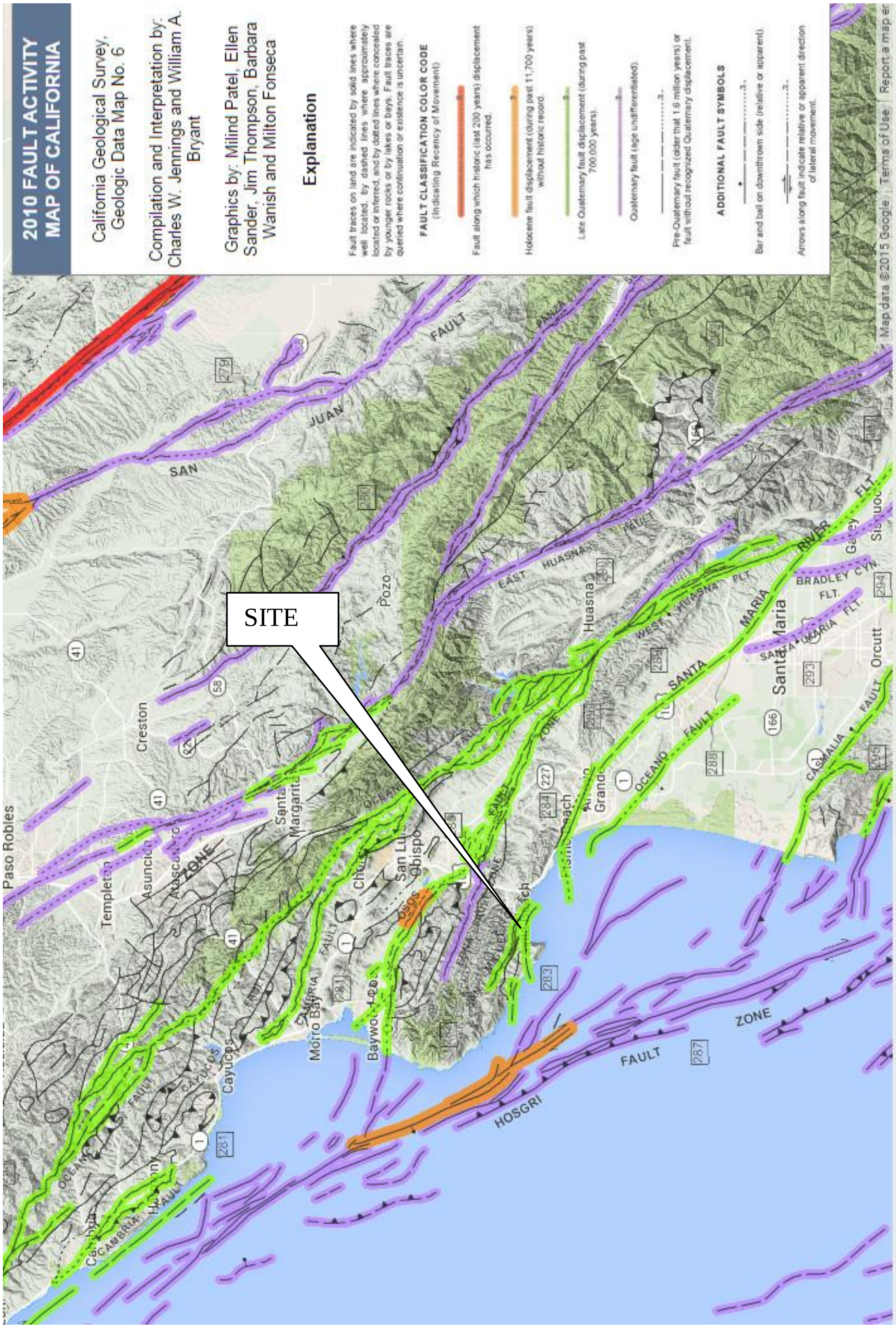
GEOLOGIC EXPLANATIONS

AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
5B

PROJECT NO:
SL03926-7



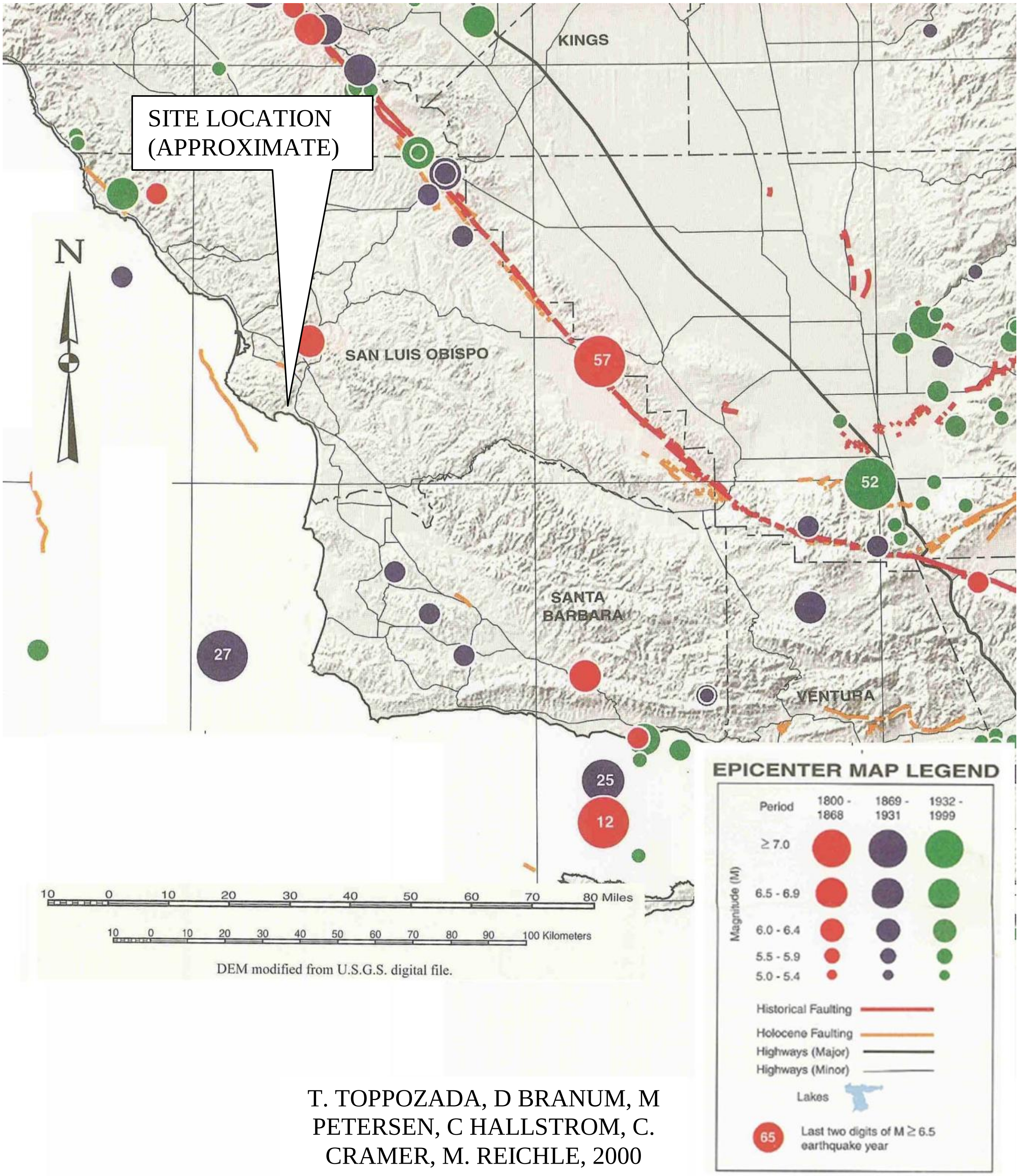
REGIONAL FAULT MAP

Jennings, 2010

AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
6

PROJECT NO:
SL03926-7



DEM modified from U.S.G.S. digital file.

T. TOPPOZADA, D BRANUM, M PETERSEN, C HALLSTROM, C. CRAMER, M. REICHLE, 2000

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HISTORICAL SEISMCITY MAP

AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
7

PROJECT NO:
SL03926-7

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AERIAL PHOTOGRAPH

ASCS-USDA, 1939 (152)

AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
8

PROJECT NO:
SL03926-7

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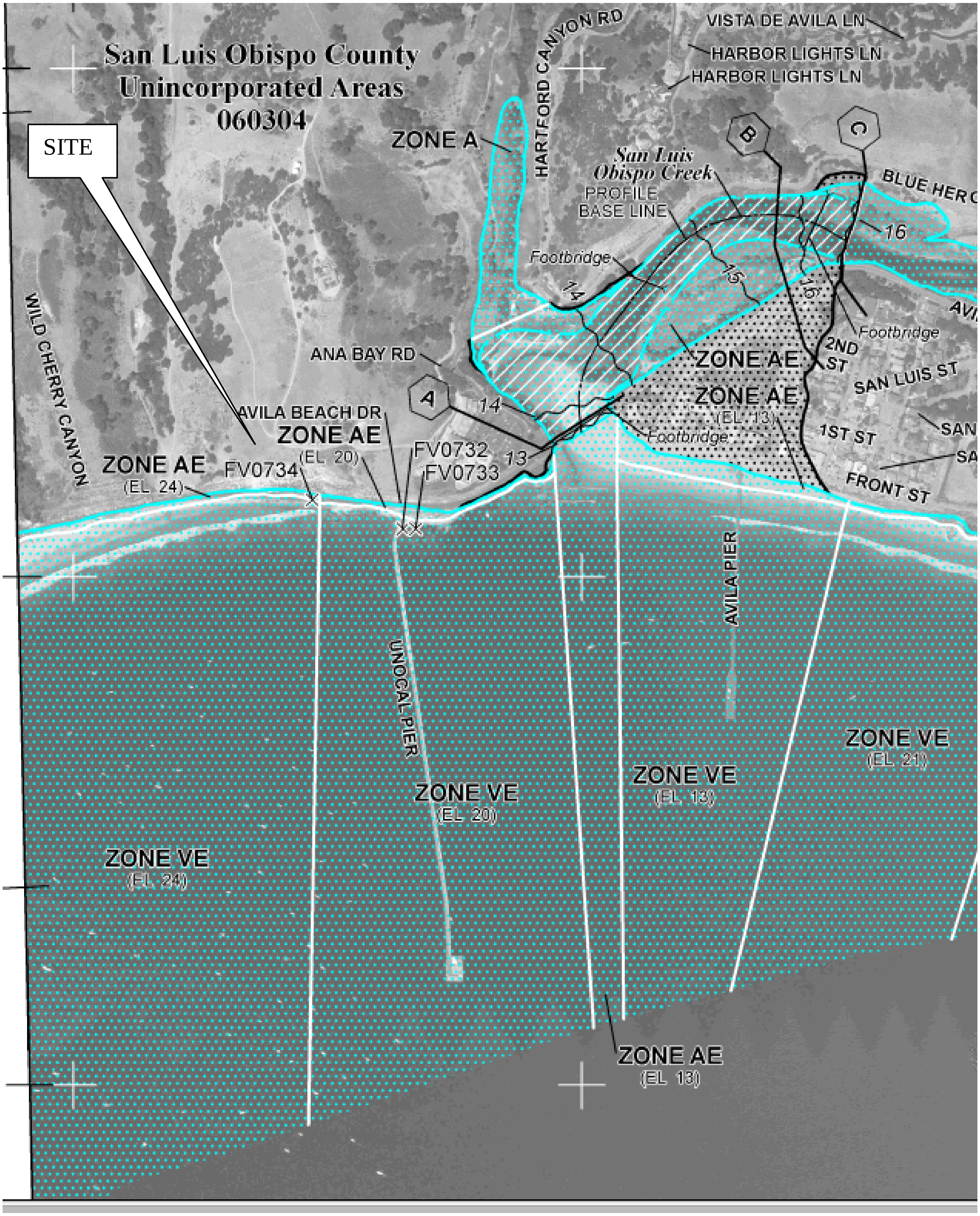
AERIAL PHOTOGRAPH

GOLDEN STATE AERIAL SURVEYS, 2002
AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
9

PROJECT NO:
SL03926-7



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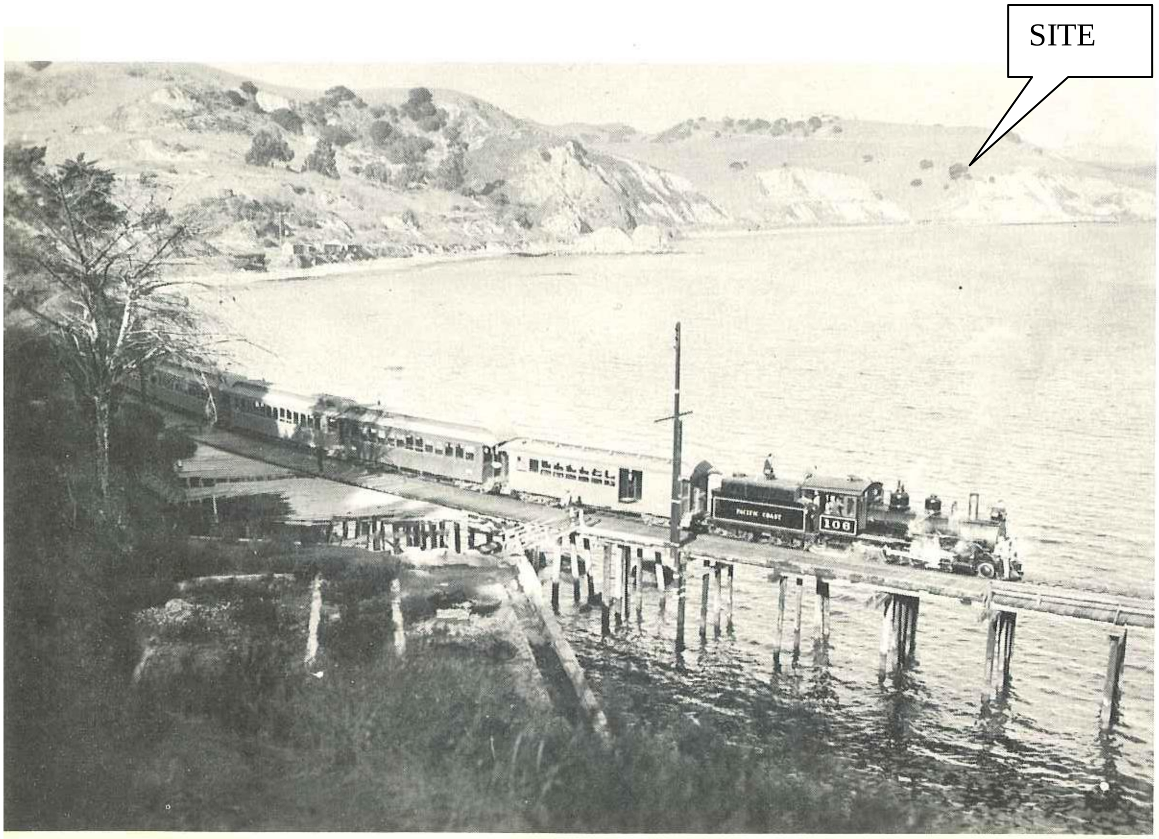
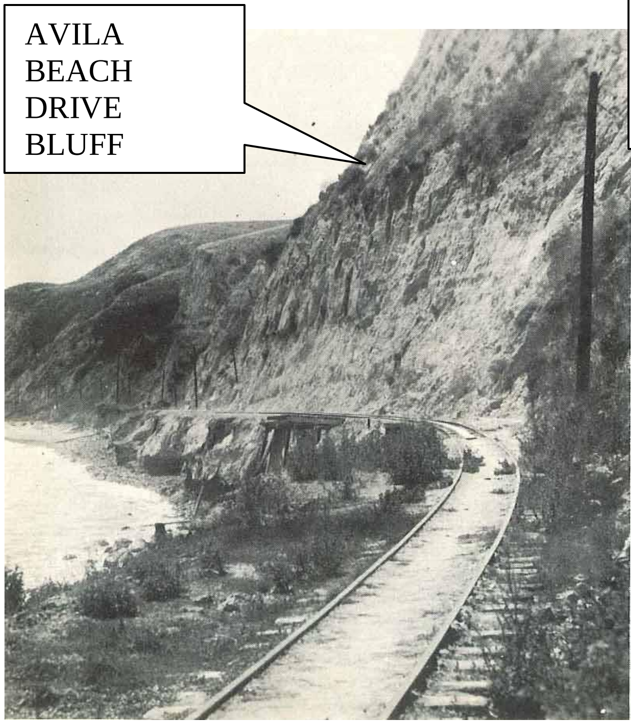
FLOOD INSURANCE RATE MAP

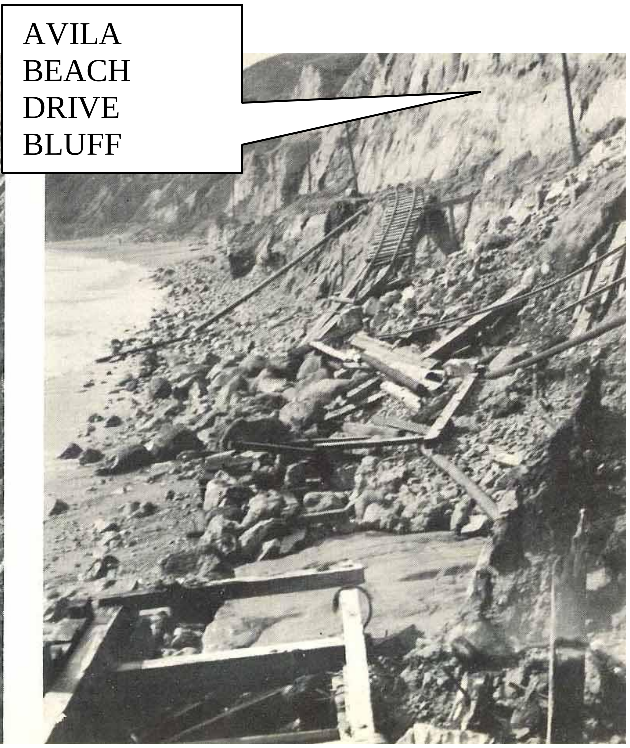
FEDERAL EMERGENCY MANAGEMENT AGENCY, 2010
AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
10

PROJECT NO:
SL03926-7







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HISTORICAL PHOTOGRAPHS

BEST 1964
AVILA BEACH COTTAGES, AVILA BEACH AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PLATE
11

PROJECT NO:
SL03926-7

APPENDIX A

Boring Logs

Laboratory Testing

Rock and Fracture Descriptors

GeoSolutions, Inc.

220 High Street
San Luis Obispo, CA 93401

RICHARD A. PFOST NO.1281 CERTIFIED ENGINEERING GEOLOGIST

BORING LOG

BORING NO. **B-1 (Amended)**

JOB NO. **SL03926-1**

PROJECT INFORMATION

PROJECT: **Seaside Garden Cottages**
DRILLING LOCATION: **See Figure 2, Site Plan**
DATE DRILLED: **2/5/04**
LOGGED BY: **ND**

DRILLING INFORMATION

DRILL RIG: **Mobile B61**
HOLE DIAMETER: **6 Inches**
SAMPLING METHOD: **CA**
HOLE ELEVATION: **~235 Feet (~223 Feet)**

▼ Depth of Groundwater: **Not Encountered**

Boring Terminated At: **15 feet**

Page 1 of 3

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	$(N_1)_{60}$	FRICTION ANGLE, (degrees)	COHESION, C (psf)	OPTIMUM WATER CONTENT (%)	MAXIMUM DRY DENSITY (pcf)	EXPANSION INDEX (EI)	PLASTICITY INDEX (PI)
0	SILTY SAND: very dark greyish brown with clay, slightly moist, medium dense Geologic Clarifications: Colluvium (Qc)	SM										
-1				X	13							
				A						117.4	6	
-2									12.3			
-3	SANDY CLAY: very dark greyish brown with silt, slightly moist, hard Geologic Clarification SANDSTONE: Squire Member of the Pismo Formation (Tpps)	CL										
-4				X	44							
				B					14.5	109.1	23	
-9				X	52							
-10	SILTY CLAY: olive brown, slightly moist, hard Geologic Clarification: SANDSTONE: Squire Member of the Pismo Formation (Tpps)	CL		C					17.3	106.5	41	
-14				X	50/6							
-15												
-20												

GeoSolutions, Inc.
220 High Street
San Luis Obispo, CA 93401

RICHARD A. PROST
NO.1281
CERTIFIED ENGINEERING GEOLOGIST

BORING LOG

BORING NO. **B-2 (Amended)**
JOB NO. **SL03926-1**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Seaside Garden Cottages**	DRILL RIG:	**Mobile B61**
DRILLING LOCATION:	**See Figure 2, Site Plan**	HOLE DIAMETER:	**6 Inches**
DATE DRILLED:	**2/5/04**	SAMPLING METHOD:	**CA**
LOGGED BY:	**ND**	HOLE ELEVATION:	**~235 Feet (~225 Feet)**

▼ Depth of Groundwater: **Not Encountered** Boring Terminated At: **15 feet** Page 2 of 3

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	$(N_1)_{60}$	FRICTION ANGLE, (degrees)	COHESION, C (psf)	OPTIMUM WATER CONTENT (%)	MAXIMUM DRY DENSITY (pcf)	EXPANSION INDEX (EI)	PLASTICITY INDEX (PI)
0	SILTY SAND: brown, with clay, slightly moist, medium dense Geologic Clarification: Colluvium (Qc)	SM										
-1				X	12							
-2												
-3												
-4				X	17							
-5												
-6												
-7	SANDY CLAY: light yellowish brown, with silt, slightly moist, hard Geologic Clarification: SANDSTONE: Squire Member of the Pismo Formation (Tpps)	CL										
-8												
-9				X	35							
-10												
-11												
-12												
-13												
-14				X	41							
-15												
-16												
-17												
-18												
-19												
-20												

GeoSolutions, Inc.

220 High Street
San Luis Obispo, CA 93401

PROFESSIONAL GEOLOGIST
RICHARD A. PROST
NO. 1231
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

BORING LOG

BORING NO. **B-3 (Amended)**

JOB NO. **SL03926-1**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Seaside Garden Cottages**	DRILL RIG:	**Mobile B61**
DRILLING LOCATION:	**See Figure 2, Site Plan**	HOLE DIAMETER:	**6 Inches**
DATE DRILLED:	**2/5/04**	SAMPLING METHOD:	**CA**
LOGGED BY:	**ND**	HOLE ELEVATION:	**~235 Feet (~220 Feet)**

▼ Depth of Groundwater: **Not Encountered** Boring Terminated At: **15 feet** Page 3 of 3

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	(N 1)60	FRICTION ANGLE, (degrees)	COHESION, C (psf)	OPTIMUM WATER CONTENT (%)	MAXIMUM DRY DENSITY (pcf)	EXPANSION INDEX (EI)	PLASTICITY INDEX (PI)
0	SILTY SAND: brown, with clay, slightly moist, loose Geologic Clarification: Colluvium (Qc)	SM	▨									
-1			▨	X	8							
-2			▨									
-3	SILTY SAND: light brown, with clay, slightly moist, very dense Geologic Clarification: SANDSTONE: Squire Member of the Pismo Formation (Tpps)	CL	▨									
-4			▨	X	50/3							
-5												
-6												
-7												
-8												
-9												
-10												
-11												
-12												
-13												
-14												
-15												
-16												
-17												
-18												
-19												
-20												

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San Luis Obispo, CA 93401

RICHARD A. PFOST
NO.1281
CERTIFIED ENGINEERING GEOLOGIST

BORING LOG

BORING NO. **B-4**

JOB NO. **SL03926-3**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Seaside Garden Cottages**	DRILL RIG:	**CME 55**
DRILLING LOCATION:	**See Plate 1, Eng. Geo. Map**	HOLE DIAMETER:	**4 Inches**
DATE DRILLED:	**2-20-08**	SAMPLING METHOD:	**CA**
LOGGED BY:	**LZ**	HOLE ELEVATION:	**197 Feet**

▼ Depth of Groundwater: **Not Encountered** Boring Terminated At: **100 Feet bgs** Page 1 of 10

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	POCKET PEN	RQD	PERCENT RECOVERED	FRICTION ANGLE, (degrees)	COHESION, C (psf)
0 to -2	SILTY SAND: dark brown to black, slightly moist to moist, Colluvium (Qc)	SM								
-3	SANDSTONE: light pale green, dry to slightly moist, severely weathered, soft to very soft, fine to coarse grained, Squire Member of the Pismo Formation (Tpps)									
-4				CA	56					
-9				CA	37					
-11	moderately weathered (at 11 feet)									
-14				CA	57					
-19				CA	29					
-23	end of auger (25 feet)/Start of Coring									
-24				CA	46					
-26	SANDSTONE: pale green, soft to very soft, moderately to slightly weathered, slight oxidation, very fine to medium grained, Squire Member of the Pismo Formation (Tpps)					4.75	0	8		
-31						4.75	0	12		
-36						4.75	35	40		
-41							0	N/R		
-46						4.75	8.3	40		

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RICHARD A. PFOST NO.1281

BORING LOG

BORING NO (cont). **B-4**

JOB NO. **SL03926-3**

Depth of Groundwater: **Not Encountered** Boring Terminated At: **100 Feet bgs**

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	POCKET PEN	RQD	PERCENT RECOVERED	FRICTION ANGLE (degrees)	COHESION, C (psf)
-47										
-50							51.6	79		
-52	SANDSTONE AND CLAYSTONE: pale green to light gray, very soft to soft, medium to very fine grained, appears to be intermingling of green and gray, Squire Member of the Pismo Formation (Tpps)									
-55						4.75	51.6	88		
-58	SANDSTONE: pale green, two fractures with evidence of water, moderate to severe oxidation, slightly weathered to fresh, Squire Member of the Pismo Formation (Tpps) (-61.5 feet) a single zone of highly fractured rock with severe oxidation approximately 2 inches in length, dense, but still easily scratches with fingernail.									
-60						4.75	86.6	97		
-65	CLAYSTONE: light gray, soft to very soft, medium to very fine grained, Squire Member of the Pismo Formation (Tpps)					4.75	61.6	100		
-70						4.75	58.3	43		
-71	CLAYSTONE: dark gray, fresh, moderately soft to soft, fine grained to very fine grained, Squire Member of the Pismo Formation (Tpps)									
-75						4.75	83.3	59		
-80						4.75	75.0	100		
-85						4.75	96.7	82		
-90						4.75	98.3	82		
-95						4.75	63.3	54		
-100										

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RICHARD A. PFOST
NO.1281

BORING LOG

BORING NO. **B-5**
JOB NO. **SL03926-3**

PROJECT INFORMATION

PROJECT: **Seaside Garden Cottages**
DRILLING LOCATION: **See Plate 1, Eng. Geo. Map**
DATE DRILLED: **2-4-08**
LOGGED BY: **LZ**

DRILLING INFORMATION

DRILL RIG: **CME 55**
HOLE DIAMETER: **8 Inches**
SAMPLING METHOD: **CA**
HOLE ELEVATION: **221 Feet**

▼ Depth of Groundwater: **Not Encountered**
Boring Terminated At: **85 Feet bgs**

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	POCKET PEN	RQD	PERCENT RECOVERED	FRICTION ANGLE, (degrees)	COHESION, C (psf)
0		SM								
-1	SILTY CLAY: black, slightly moist, Colluvium (Qc)									
-4				CA	50/5"					
-9				CA	49					
-10	SANDSTONE: pale green, slightly moist, very soft to soft, intensely, weathered, Squire Member of the Pismo Formation (Tpps)									
-14				CA	39					
-19				CA	33					
-20	moderately weathered									
-23	slightly weathered									
-24				CA	26					
-29				CA	22					
-34				CA	28					
-39				CA	52					
-40	end of auger (40 feet)/Start of Coring									
-41							85	43		
-42	SANDSTONE: pale green, slightly moist, very soft to soft, intensely, weathered, Squire Member of the Pismo Formation (Tpps)									
-46							65	100		

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RICHARD A. PROST
NO. 1281

BORING LOG

BORING NO (cont). **B-5**

JOB NO. **SL03926-3**

Depth of Groundwater: **Not Encountered** Boring Terminated At: **85 Feet bgs** Page 4 of 10

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	POCKET PEN	RQD	PERCENT RECOVERED	FRICTION ANGLE (degrees)	COHESION, C (psf)
-47										
-48	SILTSTONE AND CLAYSTONE: gray, moderately soft to soft, Squire Member of the Pismo Formation (Tpps)		▨							
-50			▨			4.75	100	100		
-55			▨			4.75	68.3	53		
-60			▨			4.75	95	100		
-65			▨			4.75	43.3	100		
-70			▨			4.75	56.6	78		
-75			▨			4.75	70	80		
-80			▨			4.75	0	N/R		
-85										
-90										
-95										
-100										

GeoSolutions, Inc.

220 High Street
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PROFESSIONAL GEOLOGIST
RICHARD A. PFOST
NO.1281
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

BORING LOG

BORING NO. **B-6**

JOB NO. **SL03926-3**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Seaside Garden Cottages**	DRILL RIG:	**CME 55**
DRILLING LOCATION:	**See Plate 1, Eng. Geo. Map**	HOLE DIAMETER:	**8 Inches**
DATE DRILLED:	**3/6/08**	SAMPLING METHOD:	**CA**
LOGGED BY:	**LZ**	HOLE ELEVATION:	**35 Feet**

▼ Depth of Groundwater: **Not Encountered**

Boring Terminated At: **50 Feet bgs**

Page 5 of 10

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	POCKET PEN	RQD	PERCENT RECOVERED	FRICTION ANGLE, (degrees)	COHESION, C (psf)
0 to -2	SILTY SAND: pale green, dry, Colluvium (Qc)	SM								
-2 to -19	SILTY SAND: pale brown, slightly moist, Colluvium (Qc)	SM								
-4				CA	52					
-9				CA	26					
-14				CA	9					
-19 to -25	SANDSTONE: pale brown, intensely to moderately weathered, coarse to fine grained, soft to very soft, Squire Member of the Pismo Formation (Tpps)									
-19				CA	9					
-24	End of Auger/Start of Coring			CA	50/5"					
-25 to -48	SANDSTONE: pale brown, Squire Member of the Pismo Formation (Tpps)									
-25 to -30						4.75	45.8	72		
-30 to -35						4.75	46.6	68		
-35 to -40						4.75	53.3	59		
-40 to -45						4.75	71.6	53		
-45 to -50						4.75	30	30		
-48 to -50	BASALT: Franciscan Complex (Jfv), pillow, highly fractured, slightly weathered to fresh, very hard to moderately hard									

RICHARD A. PFOST NO.1281

BORING LOG

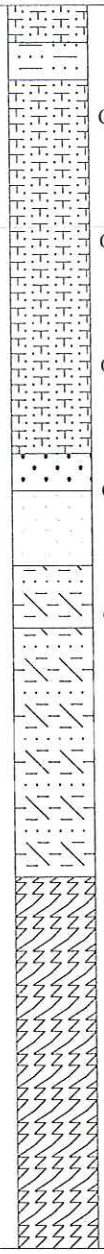
BORING NO. **B-7**

JOB NO. **SL03926-3**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Seaside Garden Cottages**	DRILL RIG:	**CME 55**
DRILLING LOCATION:	**See Plate 1, Eng. Geo. Map**	HOLE DIAMETER:	**8 Inches**
DATE DRILLED:	**3-3-08**	SAMPLING METHOD:	**CA**
LOGGED BY:	**LZ**	HOLE ELEVATION:	**~31 Feet**

▼ Depth of Groundwater: **Not Encountered**

Boring Terminated At: **50 Feet bgs**



DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	POCKET PEN	RQD	PERCENT RECOVERED	FRICTION ANGLE, (degrees)	COHESION, C (psf)
-1	SILTY SAND: greenish, moist, Colluvium (Qc)	SM								
-3	SANDY SILT: greenish brown, slightly moist, Colluvium (Qc)	SM								
-5	SILTY SAND: greenish brown, moist, Colluvium (Qc)	SM		CA	41					
-10				CA	9					
-15				CA	9					
-19	SAND: gray, medium to coarse grained, Colluvium (Qc)	SM								
-20				CA	15					
-21	SANDSTONE: pale green to greenish brown, Squire Member of the Pismo Formation (Tpps)									
-24	CLAYSTONE: gray, moderately soft to soft, slightly weathered to fresh, Squire Member of the Pismo Formation (Tpps) End of Auger/Start of Coring									
-25				CA	50/5"					
-26						4.75	46.6	80		
-28	CLAYSTONE: gray, moderately soft to soft, slightly weathered to fresh, with 1/4 inch pieces of gravel at 31 feet, Squire Member of the Pismo Formation (Tpps)									
-31						4.75	58.3	100		
-36	BASALT: highly fractured, brittle, slightly weathered to fresh, very hard to moderately hard, Franciscan Complex (Jfv)					4.75	6.6	40		
-41						4.75	35	77		
-46						4.75	31.6	80		
-50										

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RICHARD A. PFOST
NO.1281

BORING LOG

BORING NO. **B-8**

JOB NO. **SL03926-3**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Seaside Garden Cottages**	DRILL RIG:	**CME 55**
DRILLING LOCATION:	**See Plate 1, Eng. Geo. Map**	HOLE DIAMETER:	**8 Inches**
DATE DRILLED:	**2-7-08**	SAMPLING METHOD:	**CA**
LOGGED BY:	**LZ**	HOLE ELEVATION:	**178.6 Feet**

▼ Depth of Groundwater: **Not Encountered** Boring Terminated At: **100 Feet bgs** Page 7 of 10

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	POCKET PEN	RQD	PERCENT RECOVERED	FRICTION ANGLE, (degrees)	COHESION, C (psf)
0		SM								
-1	CLAY: black, slightly moist, Colluvium (Qc)									
-3	SANDSTONE: intensely weathered, soft to very soft, massive, Squire Member of the Pismo Formation (Tpps)									
-4				CA	43					
-9				CA	43					
-12	moderately weathered (14 ft)									
-14				CA	61					
-19	End of Auger/Start of Coring			CA	50/5"					
-21	SANDSTONE: pale green, very soft to soft, slightly weathered, some oxidation, fine to coarse grained, Squire Member of the Pismo Formation (Tpps)					3.5-4.75	48.3	67		
-26							48.3	88		
-31	SANDSTONE: pale green, much firmer section than other, still scratches with fingernail, Squire Member of the Pismo Formation (Tpps)					2.25-4.75	70	100		
-36							40	50		
-41	SANDSTONE: pale green, coarse to fine grained, slightly weathered, some oxidation in fractures, very soft to moderately soft, Squire Member of the Pismo Formation (Tpps)						48.3	77		
-46						0.75-1.75	13.3	22		

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RICHARD A. PFOST
NO.1281

BORING LOG

BORING NO (cont). **B-8**

JOB NO. **SL03926-3**

Depth of Groundwater: **Not Encountered** Boring Terminated At: **100 Feet bgs**

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	POCKET PEN	RQD	PERCENT RECOVERED	FRICTION ANGLE (degrees)	COHESION, C (psf)
-47	SANDSTONE: pale green, coarse to fine grained, very soft to soft, slightly weathered, Squire Member of the Pismo Formation (Tpps)									
-50						0	0	6		
-55	localized hard rock, slight oxidation, some fractures					1.9	15	75		
-60						2.5	0	8		
-65						2.25-4.75	25	9		
-70						1.2-4.75	48.3	75		
-72	SANDSTONE: pale green, coarse to fine grained, soft clay, layers up to 1/4 inch thick, slightly weathered, medium to very fine grained, some oxidation in fractures, Squire Member of the Pismo Formation (Tpps)									
-75						0.5-2.5	6.6	70		
-80						4.75	0	6		
-85	CLAYSTONE: dark bluish gray, moderately hard to soft, fine to very fine grained, fresh to slightly weathered, Squire Member of the Pismo Formation (Tpps)					4.25-4.75	71.6	100		
-90						4.75	87.5	100		
-95						4.75	81.6	100		
-100										

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RICHARD A. PFOST
NO.1281

BORING LOG

BORING NO. **B-9**

JOB NO. **SL03926-3**

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	**Seaside Garden Cottages**	DRILL RIG:	**CME 55**
DRILLING LOCATION:	**See Plate 1, Eng. Geo. Map**	HOLE DIAMETER:	**8 Inches**
DATE DRILLED:	**2-14-08**	SAMPLING METHOD:	**CA**
LOGGED BY:	**LZ**	HOLE ELEVATION:	**211 Feet**

▼ Depth of Groundwater: **Not Encountered**　Boring Terminated At: **85 Feet bgs**　Page 9 of 10

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	POCKET PEN	RQD	PERCENT RECOVERED	FRICTION ANGLE, (degrees)	COHESION, C (psf)
0		SM								
-1	CLAYEY SAND: black, with organics, slightly moist, Colluvium (Qc)									
-3	SANDSTONE: pale green to white, very soft, highly weathered, coarse to fine grained, slightly moist, Squire Member of the Pismo Formation (Tpps)									
-4				CA	43					
-9				CA	51					
-13	end of auger/Start of Coring									
-14				CA	50/5"					
-15						4.0-4.25	26.6	32		
-16	SANDSTONE: pale green, coarse to fine grained, very soft to soft, slightly weathered, Squire Member of the Pismo Formation (Tpps)									
-19				CA						
-20						0.25-3.5	0	3		
-21	SANDSTONE: pale green, medium to coarse grained, soft to very soft, slightly weathered, Squire Member of the Pismo Formation (Tpps)									
-25							0	5		
-30						2.25-4.75	6.6	28		
-35						1.5-4.75	6.6	48		
-40						.5-4.75	23.3	25		
-41	SANDSTONE: pale green, with some gray splotches, fine to coarse grained, soft to very soft, Squire Member of the Pismo Formation (Tpps)									
-45						4.75	53.3	73		
-46										

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RICHARD A. PFOST NO.1281

BORING LOG

BORING NO (cont). **B-9**
JOB NO. **SL03926-3**

Depth of Groundwater: **Not Encountered** Boring Terminated At: **85 Feet bgs** Page 10 of 10

DEPTH	SOIL DESCRIPTION	USCS	LITHOLOGY	SAMPLE	BLOWS/ 12 IN	POCKET PEN	RQD	PERCENT RECOVERED	FRICTION ANGLE (degrees)	COHESION, C (psf)
-47										
-48										
-49										
-50										
-51						1-4.75	5.5	60		
-52										
-53										
-54										
-55										
-56						-	0	14		
-57										
-58										
-59										
-60										
-61	SANDSTONE: pale green, medium to coarse grained, soft to very soft, friable, Squire Member of the Pismo Formation (Tpps)					2.5-4.75	0	21		
-62										
-63										
-64										
-65										
-66							N/R	N/R		
-67										
-68										
-69										
-70										
-71						- 1.5-4.75	0	7		
-72										
-73										
-74										
-75										
-76						2.5-4.75	18	0		
-77										
-78										
-79										
-80										
-81						4.75	21	11.6		
-82										
-83										
-84										
-85	CLAYSTONE: Squire Member of the Pismo Formation (Tpps)									
-86										
-87										
-88										
-89										
-90										
-91										
-92										
-93										
-94										
-95										
-96										
-97										
-98										
-99										
-100										

GeoSolutions, Inc. **LABORARORY DATA REPORT** **(805) 543-8539**

Project:	Seaside Garden Cottages		Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust		Project #:	SL03926-1
Sample:	A	Depth: 1.0 feet	Lab #:	3970
Location:	B-1		Sample Date:	2/5/2004
			Sampled By:	ND

Soil Classification

ASTM D2487-93, D2488-93

Result: Very Dark Grayish Brown Silty SAND w/ Clay

Specification: SM

Sieve Analysis

ASTM C136-96a

Sieve Size	Percent Passing	Project Specifications
3"		-
2"		-
1 1/2"		-
1"		-
3/4"		-
No. 4	99	-
No. 8	99	-
No. 16	98	-
No. 30	97	-
No. 50	93	-
No. 100	45	-
No. 200	24.0	-

Sand Equivalent Cal 217

1		SE
2		
3		
4		

Plasticity Index

ASTM D4318-95a

Liquid Limit:	
Plastic Limit:	
Plasticity Index:	

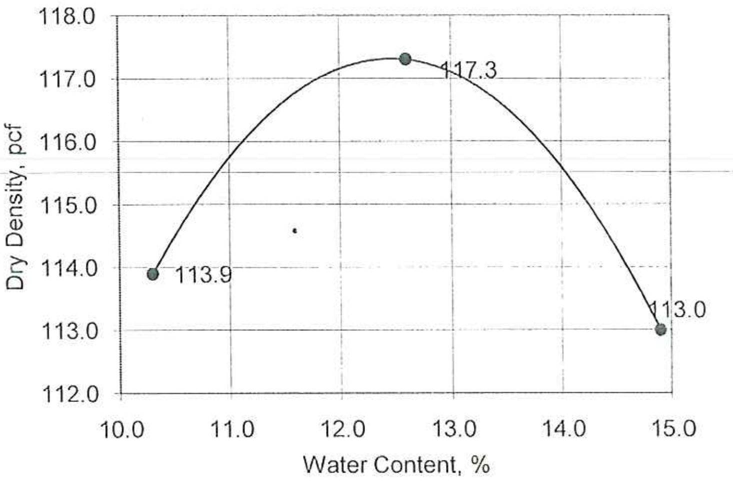
Expansion Index

ASTM D4829-95

Expansion Index:	6
Expansion Potential:	Very Low
Initial Saturation, %:	50

Laboratory Maximum Density

ASTM D1557-91



Mold ID	n/a	Mold Diameter, ins.	4.00
No. of Layers	5	Weight of Rammer, lbs.	10.00
No. of Blows	25		

Estimated Specific Gravity for 100% Saturation Curve =2.55

Trial #	1	2	3	4
Water Content:	10.3	12.6	14.9	
Dry Density:	113.9	117.3	113.0	
Maximum Dry Density, pcf:		**117.4**		
Optimum Water Content, %:		**12.3**		

Moisture-Density ASTM D2937-94, ASTM D2216-92

Sample	Depth (ft)	Water Content (%)	Dry Density (pcf)	Relative Density	Sample Description
B-1	3.5	12.0	103.8	-	Very Dark Gray Silty SAND
B-1	8.5	25.4	87.7	-	Pale Olive Silty SAND w/ Clay
B-1	13.6	27.6	88.9	-	Pale Olive Silty SAND w/ Clay
B-2	3.5	11.7	98.1	-	Very Dark Gray Silty SAND
B-2	8.5	25.7	111.7	-	Black CLAY
B-2	13.5	27.2	88.9	-	Olive Brown Clayey SILT
B-3	0.5	14.9	95.2	-	Black Silty SAND w/ Clay
B-3	3.5	6.7	90.3	-	Grayish Brown Sandy SIlt

Report By: Darren Harrold

GeoSolutions, Inc. **LABORATORY DATA REPORT** **(805) 543-8539**

Project:	Seaside Garden Cottages	Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust	Project #:	SL03926-1
Sample:	B Depth: 3.5 feet	Lab #:	3970
Location:	B-1	Sample Date:	2/5/2004
		Sampled By:	ND

Soil Classification
ASTM D2487-93, D2488-93

Result:	Very Dark Grayish Brown Sandy CLAY w/ Silt
Specification:	CL

Sieve Analysis
ASTM C136-96a

Sieve Size	Percent Passing	Project Specifications
3"		
2"		
1 1/2"		
1"		
3/4"		
No. 4		
No. 8		
No. 16		
No. 30		
No. 50		
No. 100		
No. 200		

Sand Equivalent Cal 217

1		SE
2		
3		
4		

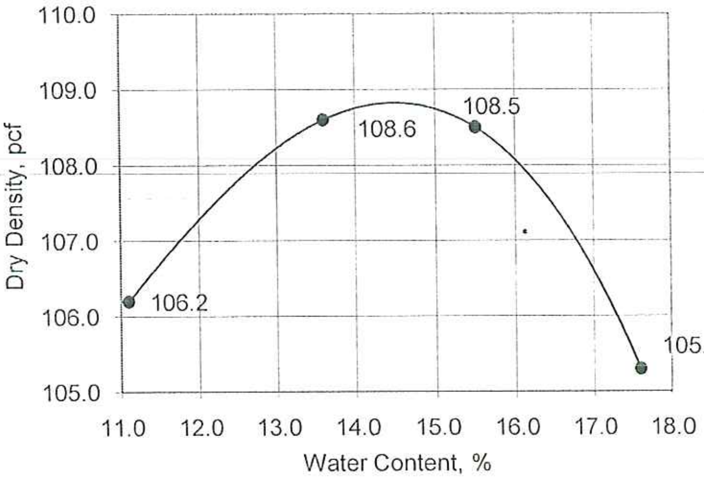
Plasticity Index
ASTM D4318-95a

Liquid Limit:	42
Plastic Limit:	19
Plasticity Index:	23

Expansion Index
ASTM D4829-95

Expansion Index:	23
Expansion Potential:	Low
Initial Saturation, %:	50

Laboratory Maximum Density
ASTM D1557-91



Mold ID	n/a	Mold Diameter, ins.	4.00
No. of Layers	5	Weight of Rammer, lbs.	10.00
No. of Blows	25		

Estimated Specific Gravity for 100% Saturation Curve =2.55

Trial #	1	2	3	4
Water Content:	11.1	13.6	15.5	17.6
Dry Density:	106.2	108.6	108.5	105.3
Maximum Dry Density, pcf:		**109.1**		
Optimum Water Content, %:		**14.5**		

Moisture-Density ASTM D2937-94, ASTM D2216-92

Sample	Depth (ft)	Water Content (%)	Dry Density (pcf)	Relative Density	Sample Description

Report By: Darren Harrold

GeoSolutions, Inc. **LABORATORY DATA REPORT** **(805) 543-8539**

Project:	Seaside Garden Cottages		Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust		Project #:	SL03926-1
Sample:	C	Depth: 10.5 feet	Lab #:	3970
Location:	B-1		Sample Date:	2/5/2004
			Sampled By:	ND

Soil Classification
ASTM D2487-93, D2488-93

Result: Olive Brown Silty CLAY

Specification: CL

Sieve Analysis
ASTM C136-96a

Sieve Size	Percent Passing	Project Specifications
3"		
2"		
1 1/2"		
1"		
3/4"		
No. 4		
No. 8		
No. 16		
No. 30		
No. 50		
No. 100		
No. 200		

Sand Equivalent Cal 217

1		SE
2		
3		
4		

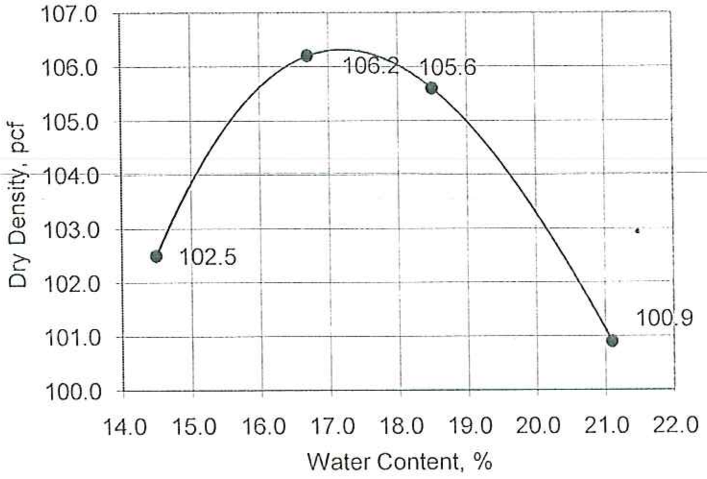
Plasticity Index
ASTM D4318-95a

Liquid Limit:	46
Plastic Limit:	21
Plasticity Index:	**25**

Expansion Index
ASTM D4829-95

Expansion Index:	41
Expansion Potential:	Low
Initial Saturation, %:	50

Laboratory Maximum Density
ASTM D1557-91



Mold ID	n/a	Mold Diameter, ins.	4.00
No. of Layers	5	Weight of Rammer, lbs.	10.00
No. of Blows	25		

Estimated Specific Gravity for 100% Saturation Curve =2.55

Trial #	1	2	3	4
Water Content:	14.5	16.7	18.5	21.1
Dry Density:	102.5	106.2	105.6	100.9
Maximum Dry Density, pcf:		**106.5**		
Optimum Water Content, %:		**17.3**		

Moisture-Density ASTM D2937-94, ASTM D2216-92

Sample	Depth (ft)	Water Content (%)	Dry Density (pcf)	Relative Density	Sample Description

Report By: Darren Harrold

GeoSolutions, Inc.

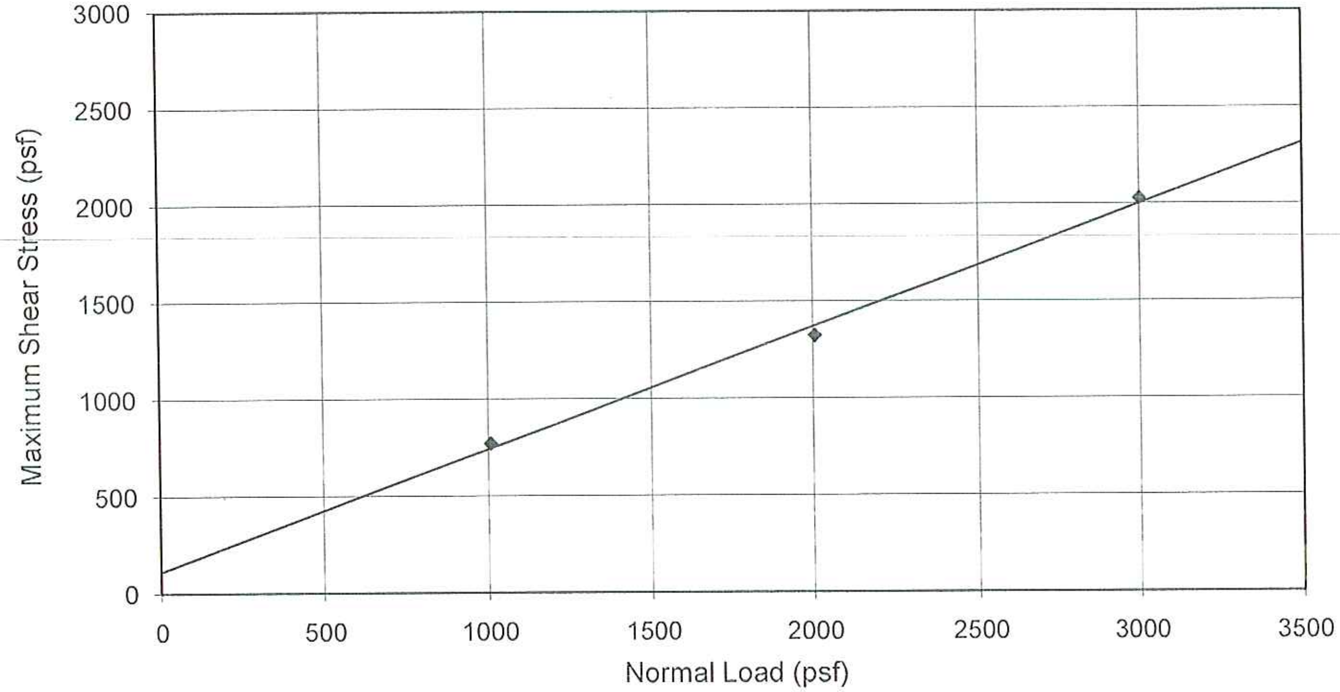
DIRECT SHEAR TEST REPORT
D-3080

(805) 543-8539

Project:	Seaside Garden Cottages	Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust	Project #:	SL03926-1
Sample #:	B-1 Depth: 0.0 feet	Lab #:	3970
Location:	B-1	Sample Date:	2/5/2004
Material:	Very Dark Gray Silty SAND	Sampled By:	ND

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density, %
1	0.487	101.2	1008	770	18.3	113.3	-
2	0.388	126.0	2007	1324	18.1	121.4	-
3	0.411	110.1	3002	2026	16.8	119.5	-
4							
5							



The test specimens were in-situ samples.

Angle of Internal Friction (In-Situ), Phi:	32.2 °
Cohesion (In-Situ), C:	111 psf

Report By: Darren Harrold

GeoSolutions, Inc.

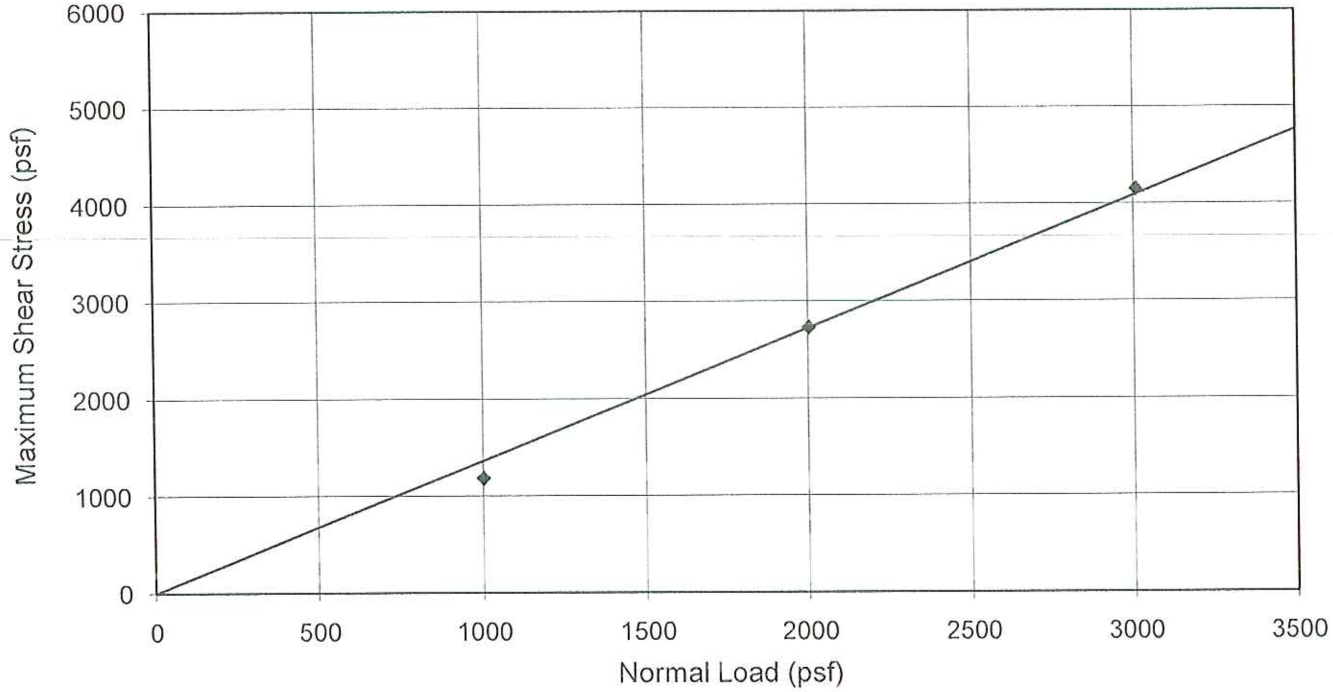
DIRECT SHEAR TEST REPORT
D-3080

(805) 543-8539

Project:	Seaside Garden Cottages	Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust	Project #:	SL03926-1
Sample #:	B-1 Depth: 3.5 feet	Lab #:	3970
Location:	B-1	Sample Date:	2/5/2004
Material:	Pale Olive Silty SAND w/ Clay	Sampled By:	ND

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density, %
1	0.732	118.0	1002	1183	32.0	97.3	-
2	0.700	119.4	2004	2728	30.9	99.2	-
3	0.903	97.8	3009	4150	32.7	88.6	-
4							
5							



The test specimens were in-situ samples.

Angle of Internal Friction (In-Situ), Phi:	53.7 °
Cohesion (In-Situ), C:	0.0 psf

Report By: Darren Harrold

GeoSolutions, Inc.

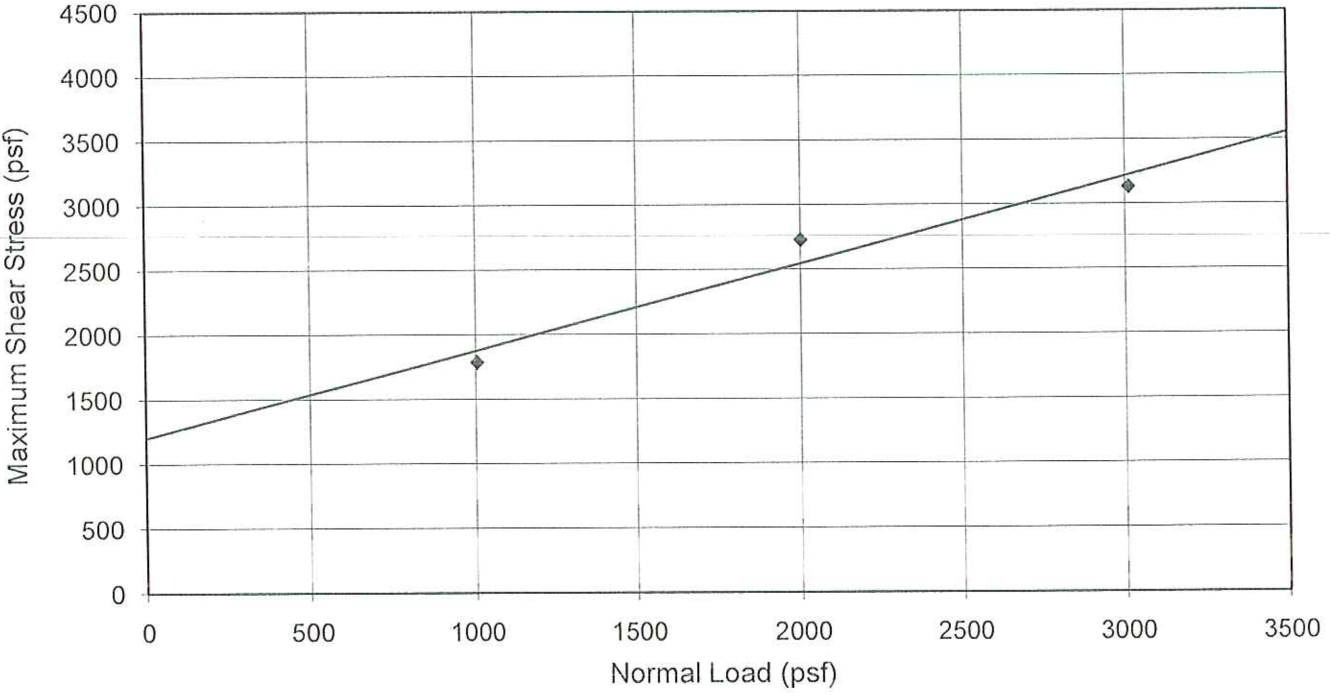
DIRECT SHEAR TEST REPORT
D-3080

(805) 543-8539

Project:	Seaside Garden Cottages	Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust	Project #:	SL03926-1
Sample #:	B-1 Depth: 8.5 feet	Lab #:	3970
Location:	B-1	Sample Date:	2/5/2004
Material:	Pale Olive Silty SAND w/ Clay	Sampled By:	ND

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density, %
1	0.803	115.2	1005	1783	34.2	93.5	-
2	0.809	104.3	2001	2729	31.3	93.2	-
3	0.733	130.8	3012	3132	35.5	97.3	-
4							
5							



The test specimens were in-situ samples.

Angle of Internal Friction (In-Situ), Phi:	33.9 °
Cohesion (In-Situ), C:	1201 psf

Report By: Darren Harrold

GeoSolutions, Inc.

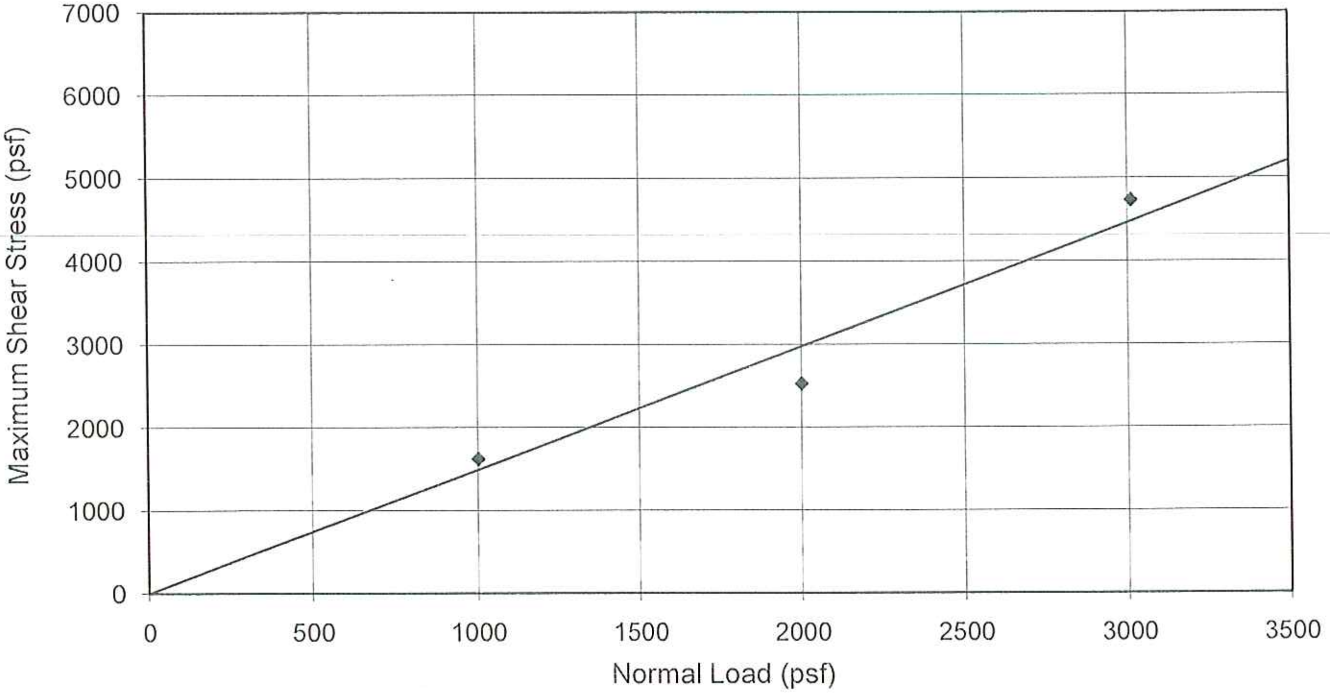
DIRECT SHEAR TEST REPORT
D-3080

(805) 543-8539

Project:	Seaside Garden Cottages	Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust	Project #:	SL03926-1
Sample #:	B-1 Depth: 13.5 feet	Lab #:	3970
Location:	B-1	Sample Date:	2/5/2004
Material:	Pale Olive Silty SAND	Sampled By:	ND

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density, %
1	0.794	121.6	1002	1618	35.8	94.0	-
2	0.901	116.7	2001	2526	39.0	88.7	-
3	0.694	129.7	3012	4733	33.3	99.5	-
4							
5							



The test specimens were in-situ samples.

Angle of Internal Friction (In-Situ), Phi:	56.1 °
Cohesion (In-Situ), C:	0 psf

Report By: Darren Harrold

GeoSolutions, Inc.

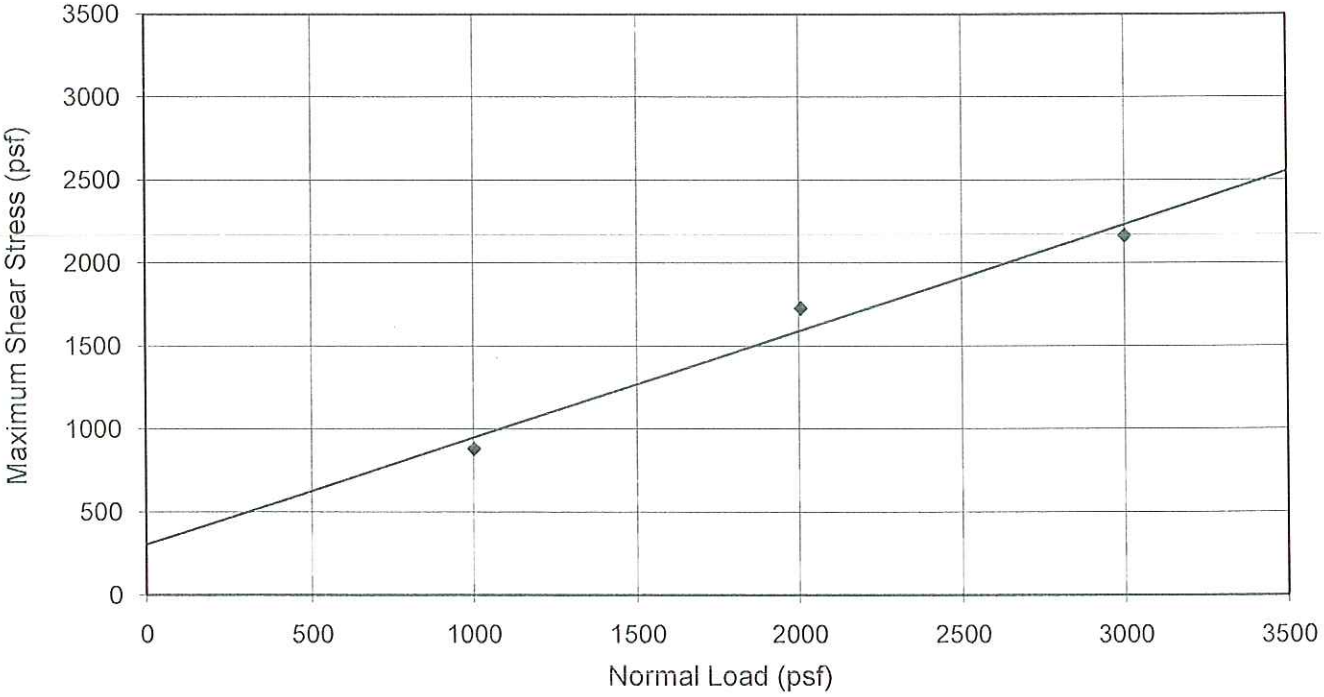
DIRECT SHEAR TEST REPORT
D-3080

(805) 543-8539

Project:	Seaside Garden Cottages	Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust	Project #:	SL03926-1
Sample #:	B-2 Depth: 0.0 feet	Lab #:	3970
Location:	B-2	Sample Date:	2/5/2004
Material:	Very Dark Gray Silty SAND	Sampled By:	ND

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density, %
1	0.602	86.1	1002	880	19.2	105.2	-
2	0.556	87.0	2007	1727	17.9	108.3	-
3	0.448	104.8	3002	2165	17.4	116.4	-
4							
5							



The test specimens were in-situ samples.

Angle of Internal Friction (In-Situ), Phi:	32.7 °
Cohesion (In-Situ), C:	303 psf

Report By: Darren Harrold

GeoSolutions, Inc.

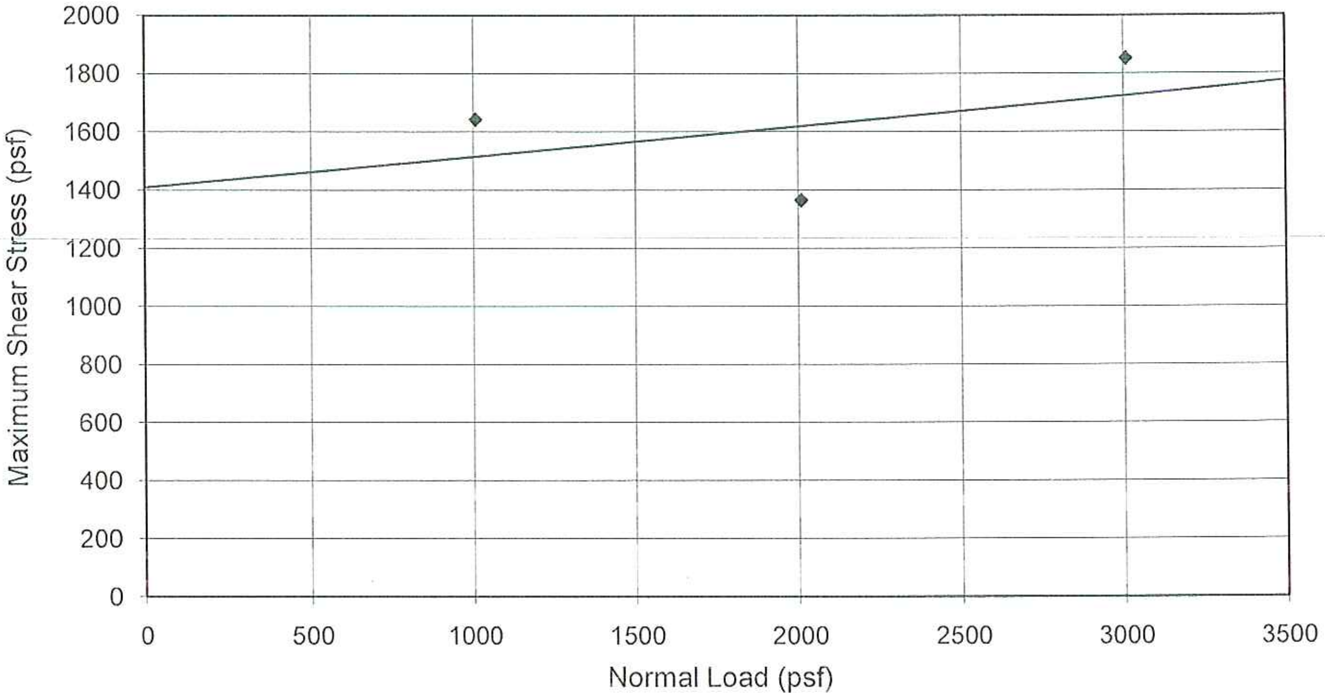
DIRECT SHEAR TEST REPORT
D-3080

(805) 543-8539

Project:	Seaside Garden Cottages	Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust	Project #:	SL03926-1
Sample #:	B-2 Depth: 3.5 feet	Lab #:	3970
Location:	B-2	Sample Date:	2/5/2004
Material:	Black CLAY	Sampled By:	ND

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density, %
1	0.749	106.8	1008	1642	29.6	96.4	-
2	0.746	102.7	2010	1365	28.4	96.5	-
3	0.659	120.8	3009	1851	29.5	101.6	-
4							
5							



The test specimens were in-situ samples.

Angle of Internal Friction (In-Situ), Phi:	5.9 °
Cohesion (In-Situ), C:	1410 psf

Report By: Darren Harrold

GeoSolutions, Inc.

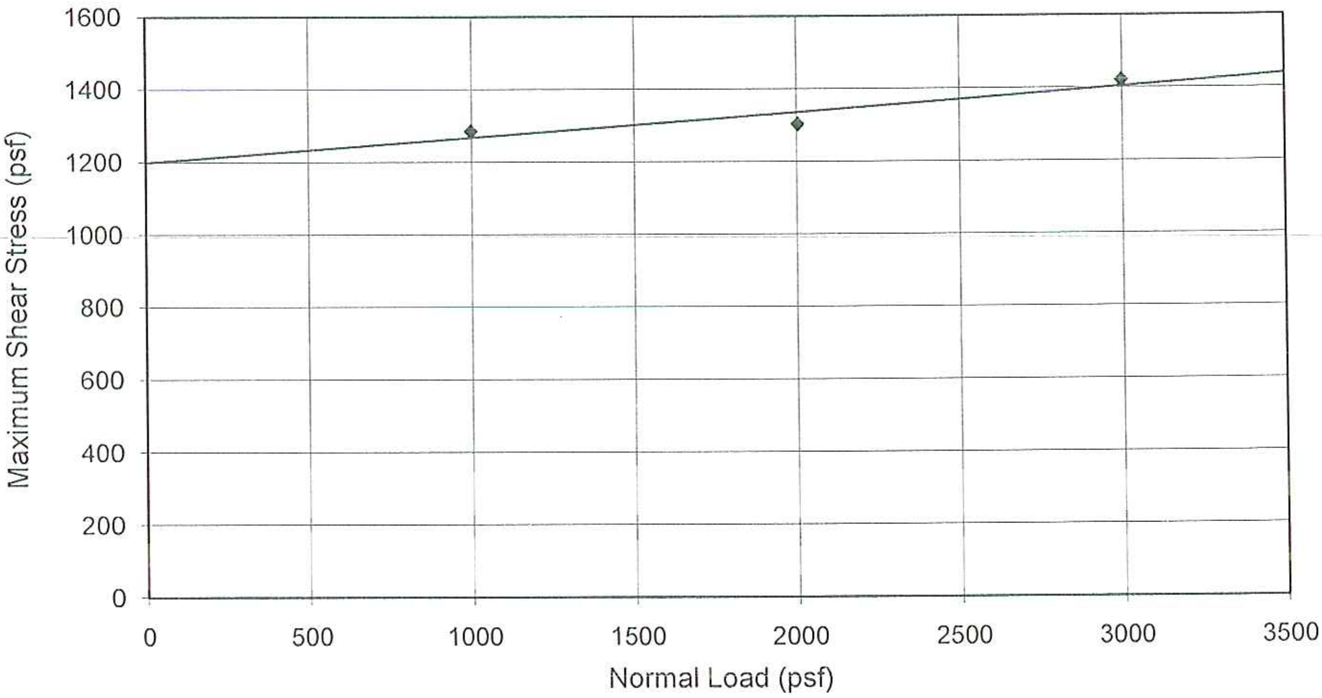
DIRECT SHEAR TEST REPORT
D-3080

(805) 543-8539

Project:	Seaside Garden Cottages	Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust	Project #:	SL03926-1
Sample #:	B-2 Depth: 8.5 feet	Lab #:	3970
Location:	B-2	Sample Date:	2/5/2004
Material:	Olive Brown Clayey SILT	Sampled By:	ND

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density, %
1	0.861	111.5	999	1284	35.5	90.6	-
2	0.659	139.9	2004	1303	34.2	101.6	-
3	0.743	126.5	2999	1420	34.8	126.5	-
4							
5							



The test specimens were in-situ samples.

Angle of Internal Friction (In-Situ), Phi:	3.9 °
Cohesion (In-Situ), C:	1199 psf

Report By: Darren Harrold

GeoSolutions, Inc.

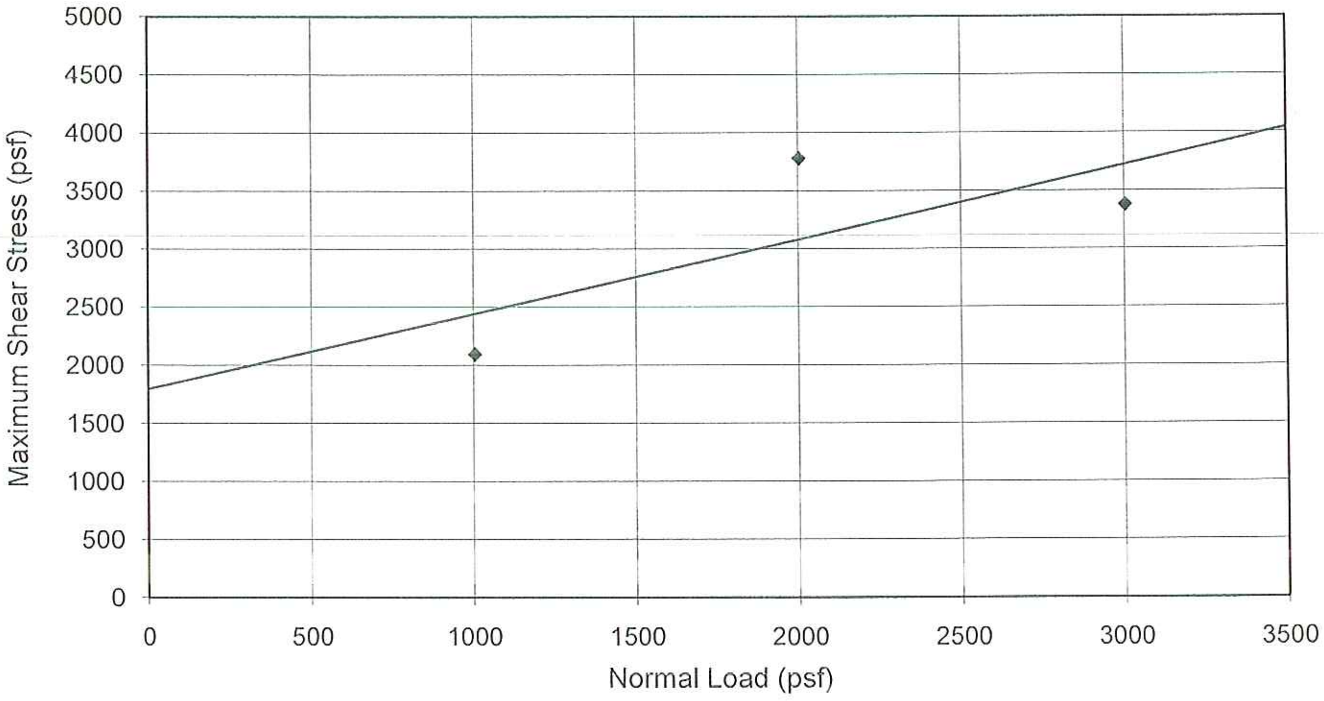
DIRECT SHEAR TEST REPORT
D-3080

(805) 543-8539

Project:	Seaside Garden Cottages	Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust	Project #:	SL03926-1
Sample #:	B-2 Depth: 13.5 feet	Lab #:	3970
Location:	B-2	Sample Date:	2/5/2004
Material:	Pale Olive Sandy SILT	Sampled By:	ND

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density, %
1	0.961	129.8	1005	2092	46.2	85.9	-
2	0.869	123.3	2004	3779	39.7	90.2	-
3	0.871	151.9	3005	3377	49.0	90.1	-
4							
5							



The test specimens were in-situ samples.

Angle of Internal Friction (In-Situ), Phi:	32.7 °
Cohesion (In-Situ), C:	1796 psf

Report By: Darren Harrold

GeoSolutions, Inc.

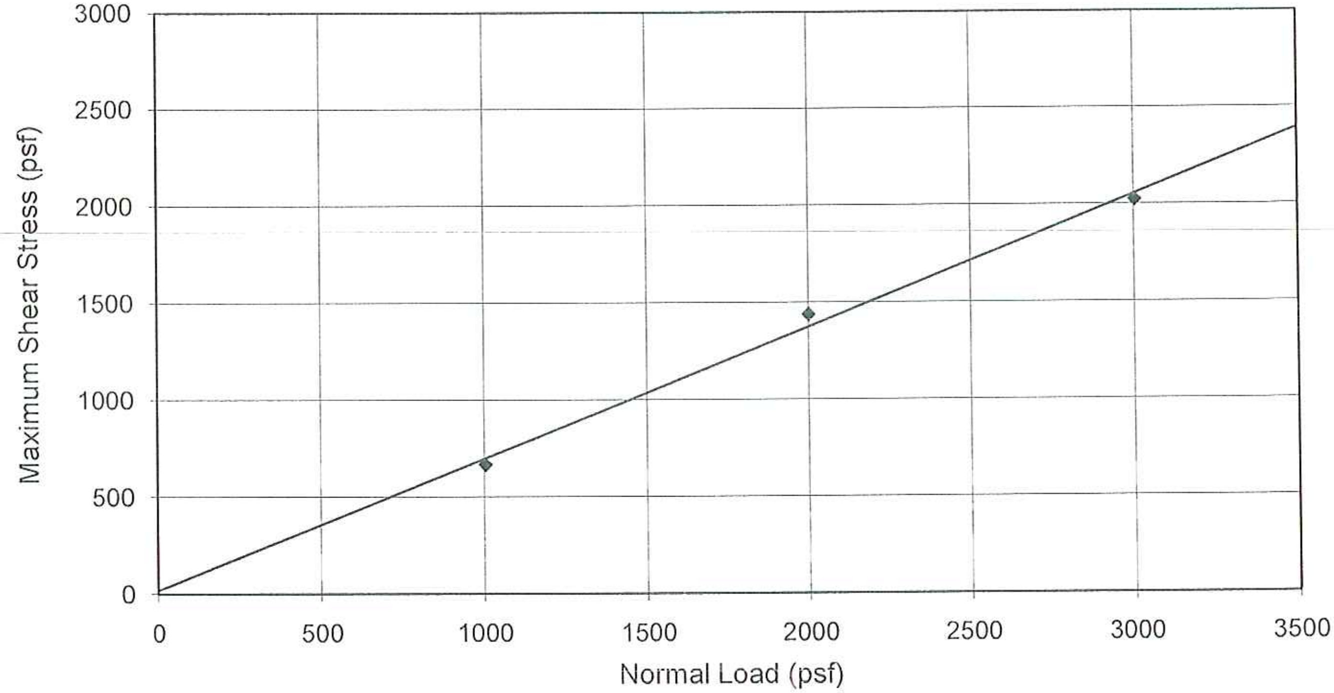
DIRECT SHEAR TEST REPORT
D-3080

(805) 543-8539

Project:	Seaside Garden Cottages	Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust	Project #:	SL03926-1
Sample #:	B-3 Depth: 0.0 feet	Lab #:	3970
Location:	B-3	Sample Date:	2/5/2004
Material:	Black Silty SAND w/ Clay	Sampled By:	ND

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density, %
1	0.661	110.6	1005	666	27.1	101.5	-
2	0.635	99.4	2001	1437	23.4	103.1	-
3	0.673	90.6	3005	2023	22.6	100.8	-
4							
5							



The test specimens were in-situ samples.

Angle of Internal Friction (In-Situ), Phi:	34.1 °
Cohesion (In-Situ), C:	17.2 psf

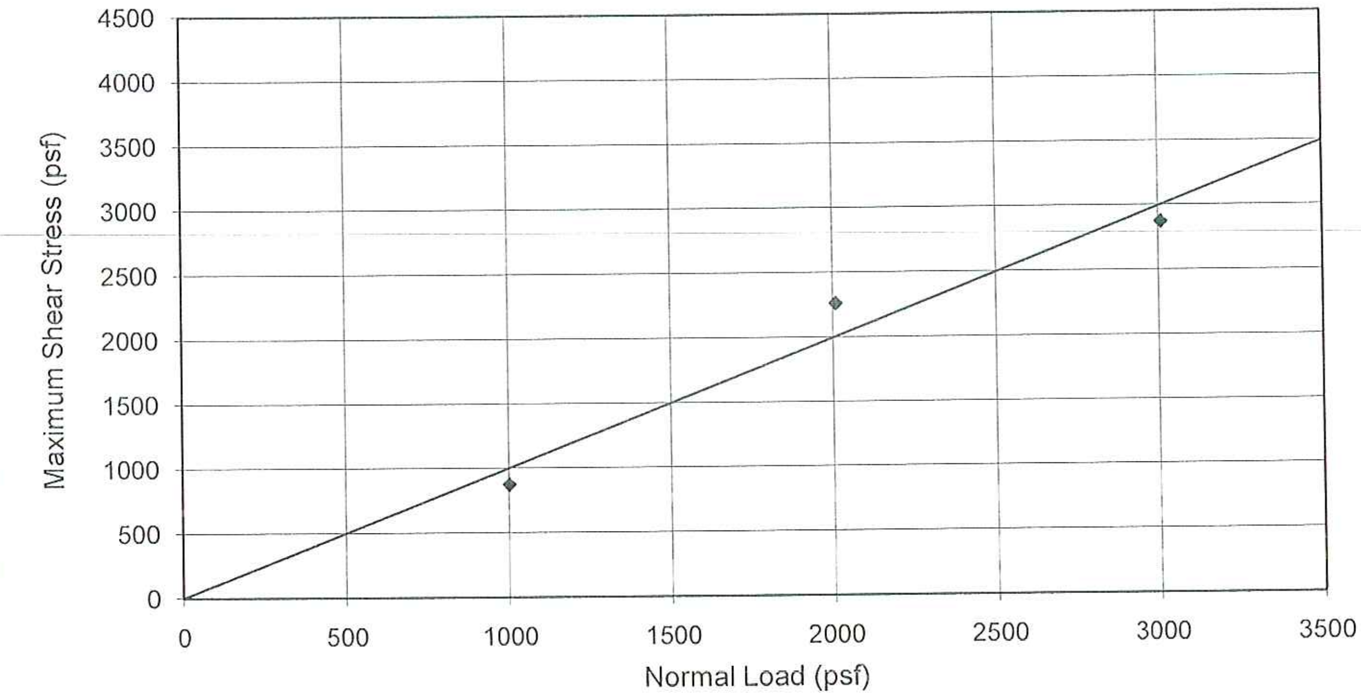
Report By: Darren Harrold

GeoSolutions, Inc.	**DIRECT SHEAR TEST REPORT** **D-3080**	**(805) 543-8539**

Project:	Seaside Garden Cottages	Date Tested:	2/17/2004
Client:	Robin L. Rossi Living Trust	Project #:	SL03926-1
Sample #:	B-3 Depth: 3.5 feet	Lab #:	3970
Location:	B-3	Sample Date:	2/5/2004
Material:	Grayish Brown Sandy SILT	Sampled By:	ND

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density, %
1	0.622	101.5	1002	873	23.4	103.9	-
2	0.546	112.0	2010	2260	22.6	109.0	-
3	0.729	83.3	3009	2871	22.5	97.5	-
4							
5							



The test specimens were in-situ samples.

Angle of Internal Friction (In-Situ), Phi:	44.9 °
Cohesion (In-Situ), C:	2.0 psf

Report By: Darren Harrold

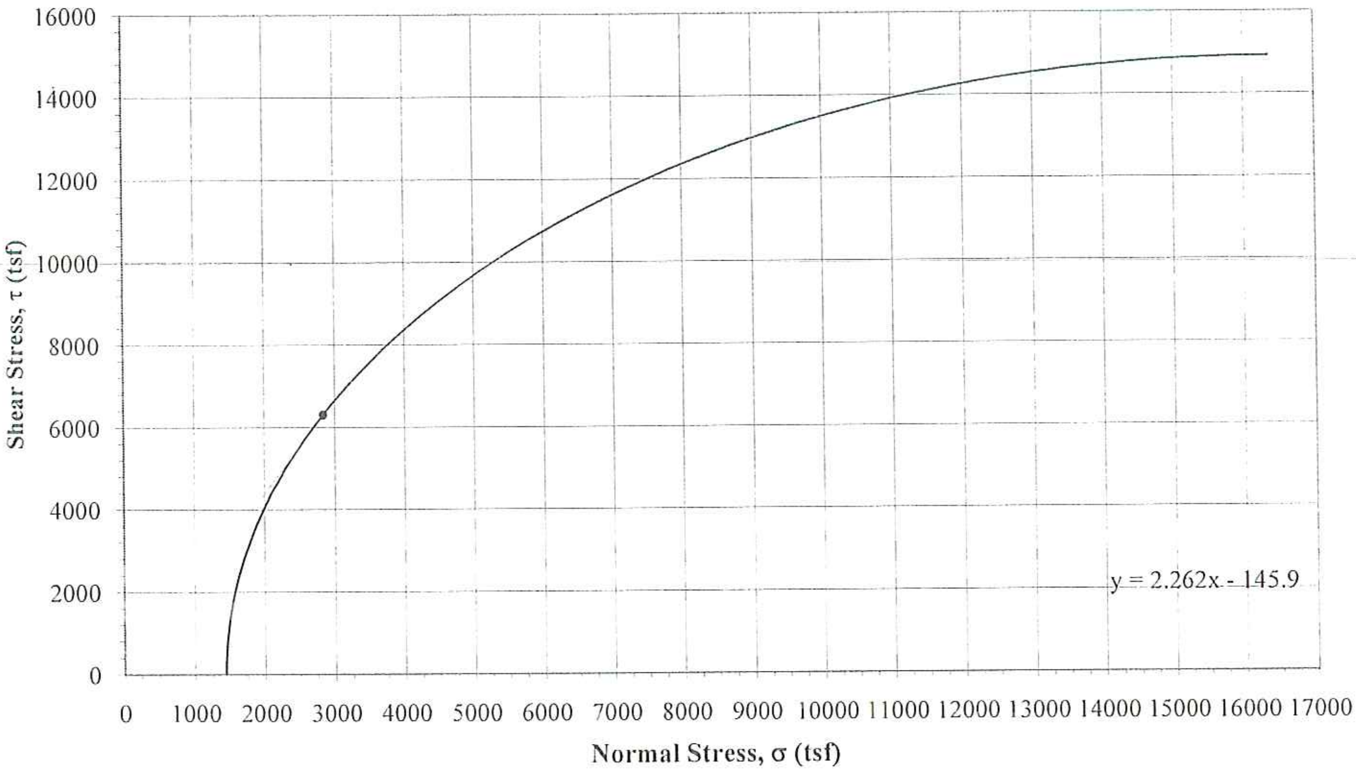
GeoSolutions, Inc.

TRIAX SHEAR TEST REPORT
D-2850

(805) 543-8539

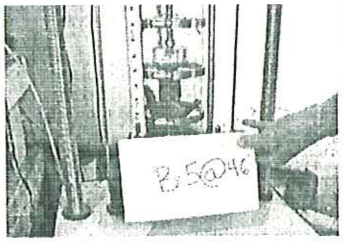
Project:	Seaside Garden Cottages			Date Tested:	2/27/08
Client:				Project #:	SL03926-3
Sample #1:	B-5	Depth:	46 ft.	Lab #:	13450
Sample#2:		Depth:		Sample Date:	2/2/08
Material:				Sampled By:	LZ

					Test Data					
Specimen Number	H_o in.	D in.	γ_d pcf	G_s	Peak Stress tsf	Cell Pressure psi	Water Content, %		Dry Density, p	Relative Density, %
1	4.85	1.75		2.7	14.924	10				-
2										
3										
4										
5										



The test specimens were in-situ samples.

Δx = -16364
Δy = -14924
α = 42.4



Angle of Internal Friction (In-Situ), Phi: °
Cohesion (In-Situ), C: 14,924 psf

Report By: Aaron Eichman

GeoSolutions, Inc.

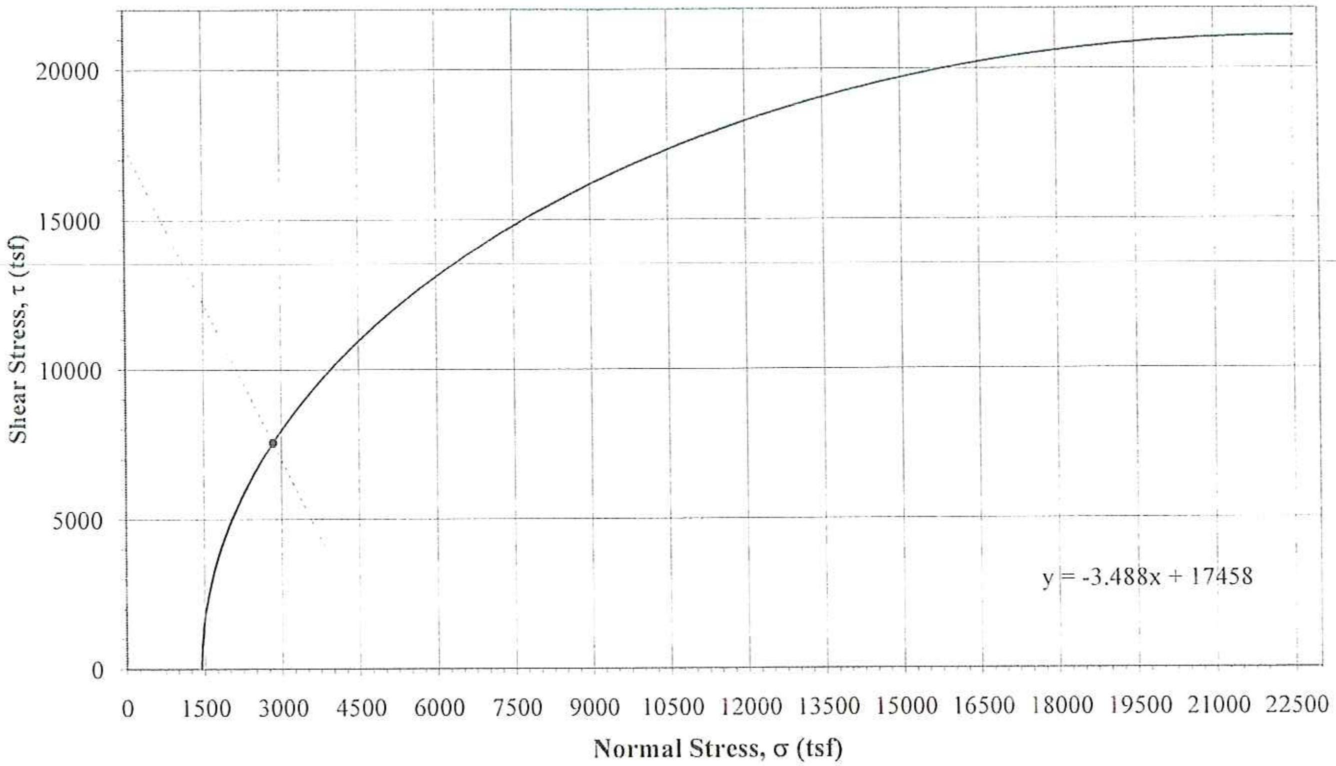
TRIAX SHEAR TEST REPORT
D-2850

(805) 543-8539

Project:	Seaside Garden Cottages			Date Tested:	2/27/08
Client:				Project #:	SL03926-3
Sample #1:	B-5	Depth:	64 ft.	Lab #:	13450
Sample#2:		Depth:		Sample Date:	2/2/08
Material:				Sampled By:	LZ

Test Data

Specimen Number	H_o in.	D in.	γ_d pcf	G_s	Peak Stress tsf	Cell Pressure psi	Water Content, %		Dry Density, p	Relative Density, %
1	4.9	1.75		2.7	21.089	10				-
2										
3										
4										
5										



The test specimens were in-situ samples.

Δx = -22529
Δy = -21089
α = 43.1

Angle of Internal Friction (In-Situ), Phi:	°
Cohesion (In-Situ), C:	21,089 psf

Report By: Aaron Eichman

GeoSolutions, Inc.

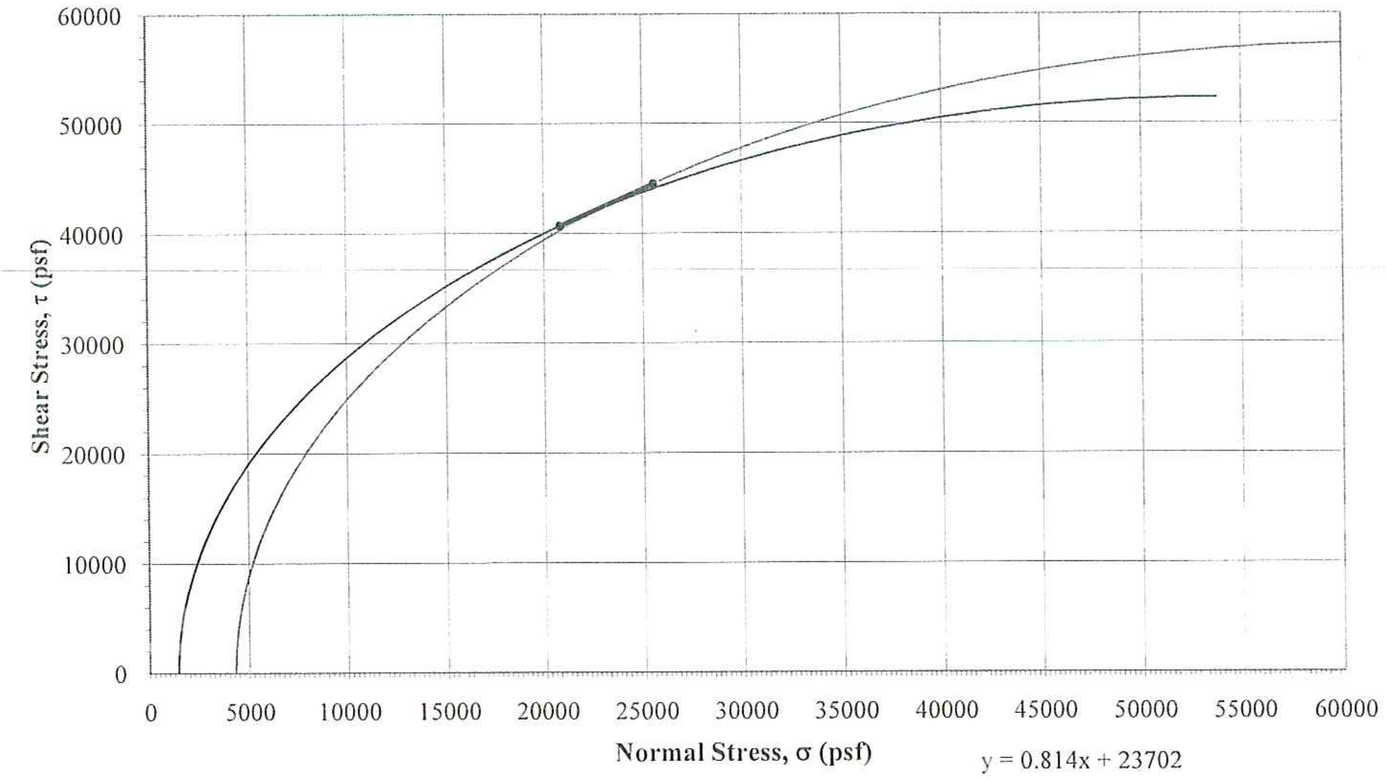
TRIAX SHEAR TEST REPORT
D-2850

(805) 543-8539

Project:	Seaside Garden Cottages			Date Tested:	May 9, 2008
Client:				Project #:	SL03926-3
Sample #1:	B-5	Depth:	64.0 Feet	Lab #:	13570
Sample#2:		Depth:		Sample Date:	April 28, 2008
Material:				Sampled By:	LZ

Test Data

Specimen Number	H_o in.	D in.	γ_d pcf	G_s	Peak Stress tsf	Cell Pressure psi	Water Content, %	Dry Density, p		Relative Density, %
1	3.8	1.75		2.7	52.342	10	6.6			-
2	4.1	1.75		2.7	57.278	30	8.1			-
3										
4										
5										



The test specimens were in-situ samples.

Δx = 7816

Δy = 4936

α = 32.3

Angle of Internal Friction (In-Situ), Phi:	39.2 °
Cohesion (In-Situ), C:	23702 psf

Report By: Aaron Eichman

ROCK DESCRIPTORS

Weathering

W1	Fresh	Body of rock is not oxidized or discolored; fracture surfaces are not oxidized or discolored*; no separation of grain boundaries; no change of texture and no solutioning. Hammer rings when crystalline rocks are struck
W2	Slightly weathered to fresh**	
W3	Slightly weathered	Discoloration or oxidation is limited to surface of, or short distance from fractures; some feldspar crystals are dull; fracture surfaces have minor to complete discoloration or oxidation; no visible separation of grain boundaries; texture preserved and minor leaching of soluble minerals may be present. Hammer rings when crystalline rocks are struck, body of rock is not weakened by weathering.
W4	Moderately to slightly weathered**	
W5	Moderately weathered	Discoloration or oxidation extends from fractures, usually throughout body of rock; ferromagnesian minerals are "rusty," feldspar crystals are "cloudy"; all fracture surfaces are discolored or oxidized; partial opening of grain boundaries visible; texture generally preserved but soluble minerals may be mostly leached. Hammer does not ring when rock is struck, body of rock is slightly weakened.
W6	Intensely to moderately weathered**	
W7	Intensely weathered	Body of rock is discolored or oxidized throughout; all feldspars and ferromagnesian minerals are altered to clay to some extent. All surfaces are discolored or oxidized, surfaces friable; partial separation of grain boundaries; rock is friable; in situ disaggregation of granitics common in semi-arid regions; texture altered and leaching of soluble minerals may be complete. Rock has dull sound when struck with hammer; rock is weakened, usually can be broken with moderate to heavy manual pressure, or by light hammer blow without reference to planes or weakness.
W8	Very intensely weathered**	
W9	Decomposed	Body of rock is discolored or oxidized throughout, but resistant minerals such as quartz may be unaltered; all feldspars and ferromagnesian minerals are completely altered to clay; complete separation of grain boundaries (disaggregated), partial or complete remnant rock structure may be preserved, but resembles a soil.
*	Characteristics of fracture surfaces do not include directional weathering along shears or faults and their associated fracture zones; for example a shear that carries weathering to great depths in a fresh rock mass would not require the whole rock mass to be classified as weathered.	
**	Combination descriptors are used where equal distribution of both weathering characteristics are present over significant intervals or where characteristics noted are "in between" the diagnostic characteristics.	

Durability Index

D10	Rock specimen or exposure remains intact with no deleterious cracking after exposure longer than 1 year.
D11	Rock specimen or exposure develops hairline cracking on surfaces within 1 month, but no disaggregation within 1 year of exposure.
D12	Rock specimen or exposure develops hairline cracking on surfaces within 1 week, and/or disaggregation within 1 month of exposure.
D13	Specimen or exposure may develop hairline cracks in 1 day and displays pronounced separation of bedding and/or disaggregation within 1 week of exposure
D14	Specimen or exposure displays pronounced cracking and disaggregation within 1 day (24 hours) of exposure. Generally ravels and degrades to small fragments.

Bedding Foliation or Flow Texture

Massive	Greater than 10 ft (>3m)
Very thickly (bedded, foliated, or banded)	3 to 10 ft (1 to 3 m)
Thickly	1 to 3 ft (300 mm to 1 m)
Moderately	0.3 to 1 ft (100 to 300mm)
Thinly	0.1 to 0.3 ft (30 to 100mm)
Very thinly	0.03 [3/8 in] to 0.1 ft (10 to 30 mm)
Laminated (Intensely foliated or banded)	Less than 0.03 ft [3/8 in] (<10 mm)

Bedrock Hardness / Strength

H1	Extremely Hard	Core, fragment or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated heavy hammer blows
H2	Very Hard	Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
H3	Hard	Can be scratched with knife or pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
H4	Moderately Hard	Can be scratched with knife or sharp pick with light or moderate pressure. Core or fragment breaks with moderate hammer blow.
H5	Moderately Soft	Can be grooved 1/16 in (2 mm) deep by knife or sharp pick with (moderate or heavy) pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
H6	Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
H7	Very Soft	Can be readily indented, grooved, or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

Note: Bedrock Units softer than H7, Very Soft, are described using USCS (soils) consistency descriptions.

GRAIN-SIZE SCALE (MM)

GRAVEL	BOULDER	>256
	COBBLE	64-256
	PEBBLE	4-64
	GRANULE	2-4
SAND	VERY COARSE SAND	1-2
	COARSE SAND	1/4-1
	MEDIUM SAND	1/4 - 1/2
	FINE SAND	1/8 -1/4
	VERY FINE SAND	1/16 – 1/8
MUD	COARSE SILT	1/32 1/16
	MEDIUM SILT	1/64 – 1/32
	FINE SILT	1/128 – 1/64
	VERY FINE SILT	1/256 –1/128
	CLAY	<1/256

Source: Wentworth, 1924

U.S. Department of the Interior, 1998, *Engineering Geology Field Manual*, Bureau of Reclamation.

CONSISTENCY

CLAYS AND PLASTIC SILTS	STRENTH TON/SQ FT	BLOWS FOOT +
Very Soft	0-1/4	0-2
Soft	1/4-1/2	2-4
Firm	1/2-1	4-8
Stiff	1-2	8-16
Very Stiff	2-4	16-32
Hard	Over 4	Over 32

RELATIVE DENSITY

SANDS, GRAVELS AND NON-PLASTIC SILTS	BLOWS FOOT+
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

1/12/07

Format for the Description of Fractures

- Orientation
- Spacing
- Continuity
- Openness
- Fillings
  - Thickness
  - Composition
- Weathering/alteration
- Hardness
- Healing
- Surfaces
  - Roughness
  - Waviness
  - Weathering/alteration
  - Hardness
- Field index test results
- Moisture

Table 5-2. – Fracture spacing descriptors

Alpha-numeric descriptor	Joint or fracture spacing descriptor	True Spacing
SP1	Extremely widely spaced	Greater than 10 feet (ft) (<3m)
SP2	Very widely spaced	3 to 10 ft (1 to 3 m)
SP3	Widely spaced	1 to 3 ft (300 mm to 1 m)
SP4	Moderately spaced	0.3 to 1 ft (100 to 300 mm)
SP5	Closely spaced	0.1 to 0.3 ft (30 to 100 mm)
SP6	Very closely spaced	Less than 0.1 ft (<30 mm)

Table 5-3. – Fracture continuity descriptors

Alpha-numeric descriptor	Descriptor	Lengths
C1	Discontinuous	Less than 3 ft (>1 m)
C2	Slightly continuous	3 to 10 ft (1 to 3 m)
C3	Moderately continuous	10 to 30 ft (3 to 10 m)
C4	Highly continuous	30 to 100 ft (10 to 30 m)
C5	Very Continuous	Greater than 110 ft (>30 m)

Table 5-4. – Descriptors for recording fracture ends in joint surveys

Alpha-numeric descriptor	Criteria
E0	Zero ends leave the exposure (both ends of the fracture can be seen in the exposure).
E1	One end can be seen (one end of the fracture terminates in the exposure).
E2	Both ends cannot be observed (two fracture ends do not terminate in the exposure).

Table 5-5. – Fracture openness descriptors

Alpha-numeric descriptor	Descriptor	Openness
00	Tight	No visible separation
01	Slightly open	Less than 0.003 ft [1/32 inch (in)] (<1mm)
02	Moderately open	0.003 to 0.01 ft [1/32 in to 1/8 in] (1 to 3 mm)
03	Open	0.01 to 0.03 ft [1/8 to 3/8 in] (3 to 10 mm)
04	Moderately wide	0.03 ft [3/8 in] to 0.1 ft (10 to 30 mm)
05	Wide	Greater than 0.1 ft (>30 mm) (record actual openness)

Table 5-6. – Fracture filling thickness descriptors

Alpha-numeric descriptor	Descriptor	Thickness
T0	Clean	No film coating
T1	Very thin	Less than 0.003 ft [1/32 inch (in)] (<1mm)
T2	Moderately thin	0.003 to 0.01 ft [1/32 in to 1/8 in] (1 to 3 mm)
T3	Thin	0.01 to 0.03 ft [1/8 to 3/8 in] (3 to 10 mm)
T4	Moderately thick	0.03 ft [3/8 in] to 0.1 ft (10 to 30 mm)
T5	Thick	Greater than 0.1 ft (>30 mm) (record actual openness)

Table 5-7. – Fracture healing descriptors

Alpha-numeric descriptor	Descriptor	Criteria
HL0	Totally healed	Fracture is completely healed or recemented to a degree at least as hard as surrounding rock.
HL2	Moderately	Greater than 50 percent of fracture material, fracture surfaces, or healed filling is healed or recemented; and/or strength of healing agent is less hard than surrounding rock.
HL3	Partly healed	Less than 50 percent of fractured material, filling, or fracture surface is healed or recemented.
HL5	Not healed	Fracture surface, fracture zone, or filling is not healed or recemented; rock fragments or filling (if present) is held in place by its own angularity and/or cohesiveness.

Table 5-8. – Fracture roughness descriptors

Alpha-numeric descriptor	Descriptor	Criteria
R1	Stepped	Near-normal steps and ridges occur on the fracture surface.
R2	Rough	Large, angular asperities can be seen.
R3	Moderately rough	Asperities are clearly visible and fracture surface feels abrasive.
R4	Slightly rough	Small asperities on the fracture surface area are visible and can be felt.
R5	Smooth	No asperities, smooth to the touch.
R6	Polished	Extremely smooth and shiny.

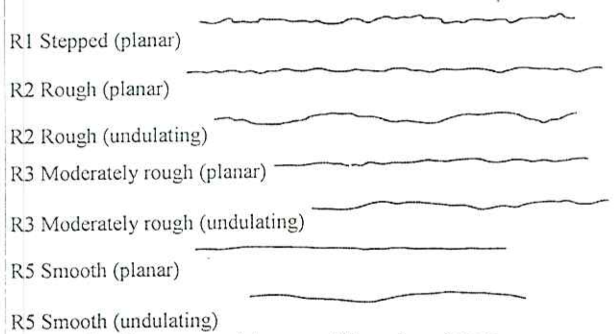


Table 5-9. – Fracture moisture conditions descriptors

Alpha-numeric descriptor	Criteria
M1	The fracture is dry, tight, or filling (where present) is of sufficient density or composition to impede water flow. Water flow along the fracture does not appear possible.
M2	The fracture is dry with no evidence of previous water flow. Water flow appears possible.
M3	The fracture is dry but shows evidence of water flow such as staining, leaching, and vegetation.
M4	The fracture filling (where present) is damp, but no free water is present.
M5	The fracture shows seepage and is wet with occasional drops of water.
M6	The fracture emits a continuous flow (estimate flow rate) under low pressure. Filling materials (where present) may show signs of leaching or piping.
M7	The fracture emits a continuous flow (estimate water flow) under moderate to high pressure. Water is squirting, and/or filling material (where present) may be substantially washed out.

U.S. Department of the Interior, 1998, *Engineering Geology Field Manual*, Bureau of Reclamation.

1/12/07

APPENDIX B

Slope Stability Evaluation – Avila Beach Drive Bluff

SLOPE STABILITY EVALUATION – AVILA BEACH DRIVE BLUFF

The purpose of the numerical slope stability analysis was to determine the horizontal distance from the top of the bluff to the back of the potential slip surface for a factor of safety of 1.5 for static conditions and 1.1 for psuedo-static conditions. As the slope may be affected by seismic events, a dynamic loading condition was applied to the existing slope (pseudo-static conditions). As stated in *Guidelines for Evaluating and Mitigating Seismic Hazards in California* (CDMG, 1997), "In California, many state and local agencies, on the basis of local experience, require the use of a seismic coefficient of 0.15, and a minimum computed pseudo-static factor of safety of 1.0 to 1.2 for analysis of natural, cut, and fill slopes. Basic guidelines for making preliminary evaluations of embankments to ensure acceptable performance…were: using a pseudo-static coefficient of 0.10 for magnitude 6.5 earthquakes and 0.15 for magnitude 8.25 earthquakes, with an acceptable factor of safety of the order of 1.15." Calculations for pseudo-static numerical analysis utilized a seismic coefficient of 0.15 g.

C-1 Location of Analyzed Profile

The natural slopes located along the southern and western property lines were analyzed to determine whether the stability was in conformance with industry requirements for slope stability. Four profiles along the southern slope and two profiles along the western slope were modeled utilizing SLOPE/W, a computer aided-modeling program. Profile A through D traverse the Site from north to south (through the Avila Beach Drive Slope) and Profile E through F (through the Wild Cherry Canyon Slope) traverse the Site from west to east, refer to Plate 1, Site Engineering Geology Map. The locations of the borings and the top of bluff are approximately identified on Plate 1. The profiles were complied and analyzed during the referenced Geologic Coastal Bluff Evaluation (GeoSolutions, May 30, 2008). The topography used is presented on Plate 4.

C-2 Modeling Conditions

General modeling conditions included: 1) approximately 1.0 to 19.0 feet of colluvium (Qc); 2) underlying sandstone of the Squire Member of the Pismo Formation (Tps) and Franciscan Complex (Kfv); and 3) groundwater at mean high tide elevation (even though groundwater location from the subsurface is unknown).

The Engineering Geologist determined the final profile by interpreting the surface and subsurface geologic conditions, available geologic map/publications, and observations made during the field investigation. The stability analysis was performed utilizing the subsurface materials recovered from drilling operations. The engineering properties of the materials utilized in the numerical analysis are presented

Table C-1: Engineering Properties Utilized in Numerical Analysis

The Numerical Analysis was Performed Utilizing Following Data:

Colluvium (Qc):
γ_w = 131.8- from laboratory test data (Sample A @ 1')
ϕ = 25.8° - from laboratory test data (B-1 @ 0', reduced 20%)
c = 88.8 psf - from laboratory test data (B-1 @ 0', reduced 20%)
Squire Member of the Pismo Formation (Tpps):
γ_w = 124.9 - from laboratory test data (Sample C @ 10')
ϕ = 26.2° - from laboratory test data (B-2 @ 13.5', reduced 20%)
c = 1436.8 psf - from laboratory test data (B-2 @ 13.5', reduced 20%)
Franciscan Complex (KJfm):
It was assumed that the slip surface would not traverse this material.

in Table C-1. A triaxial shear test (unconfined compressive) was performed on two samples within the Squire Member of the Pismo Formation and resulted in a cohesion varying from 14,924 to 21,089 psf. In order to obtain a factor of safety, the cohesion from an available representative direct shear test was utilized. In accordance with CDMG Special Publication 117, the residual strength should be used for fine-grained, low plasticity materials that are likely to be subject to significant weathering over the life of the project. Therefore, the peak strength values were reduced 20 percent and the resulting strength values utilized in the analysis was an angle of internal friction of 26.2 degrees and cohesion of 1436.8 psf.

C-3 Discussion of Results of Numerical Analysis

Table C-2: Horizontal Distance from Top of Bluff to Potential Slip Surfaces

Profile	**Static**		**Psuedo-Static**	
	Factor of Safety	**Horizontal Distance***	**Factor of Safety**	**Horizontal Distance***
Profile A	1.86	21 feet	1.45	20.5 feet
Profile B	1.5	13 feet	1.1	15 feet
Profile C	1.5	23 feet	1.1	12 feet
Profile D	1.5	13 feet	1.15	22.5 feet
Profile E	2.5	27 feet	1.78	27 feet
Profile F	2.63	22 feet	1.80	22 feet

*Horizontal Distance refers to the horizontal distance form the top of the bluff to the back of the potential critical slip surface (or that slip surface associated with a minimum static factor of safety of 1.5 or psuedo-static factor of safety of 1.1).

The critical factor of safety values for both static and psuedo-static conditions along Profiles A through F were 1.5 or above and 1.1 or greater, respectively. The static analysis resulted in factor of safety values varying from 1.5 to 2.63 with a horizontal distance from the top of the bluff to the back of the potential slip surface varying from 13 to 27 feet. The psuedo-static analysis resulted in a varying factor of safety of 1.1 to 1.8 with a horizontal distance from the top of the bluff to the back of the potential slip surface varying from 12 to 27 feet. The horizontal distance for Profiles A through F from the top of bluff to the potential critical slip surface, as well as the respective factor of safety values are presented in Table C-2. Figures C-1 through C-6 illustrate Profiles A through F with the potential slip surfaces and their respective horizontal distances for static and psuedo-static conditions.

The factor of safety values for Profile A (static and pseudo-static), Profile D (static and pseudo-static), and Profiles E and F (static and pseudo-static) are greater than the 1.5 and 1.1 required for determining the horizontal distance for setback from the bluff top. However, these values represent the critical factor of safety and therefore factors of safety 1.5 and 1.1 for static and pseudo-static analysis, respectfully, are exceeded with the modeling conditions utilized. The horizontal distances for these cases were determined from the potential slip surfaces associated with the critical factor of safety.

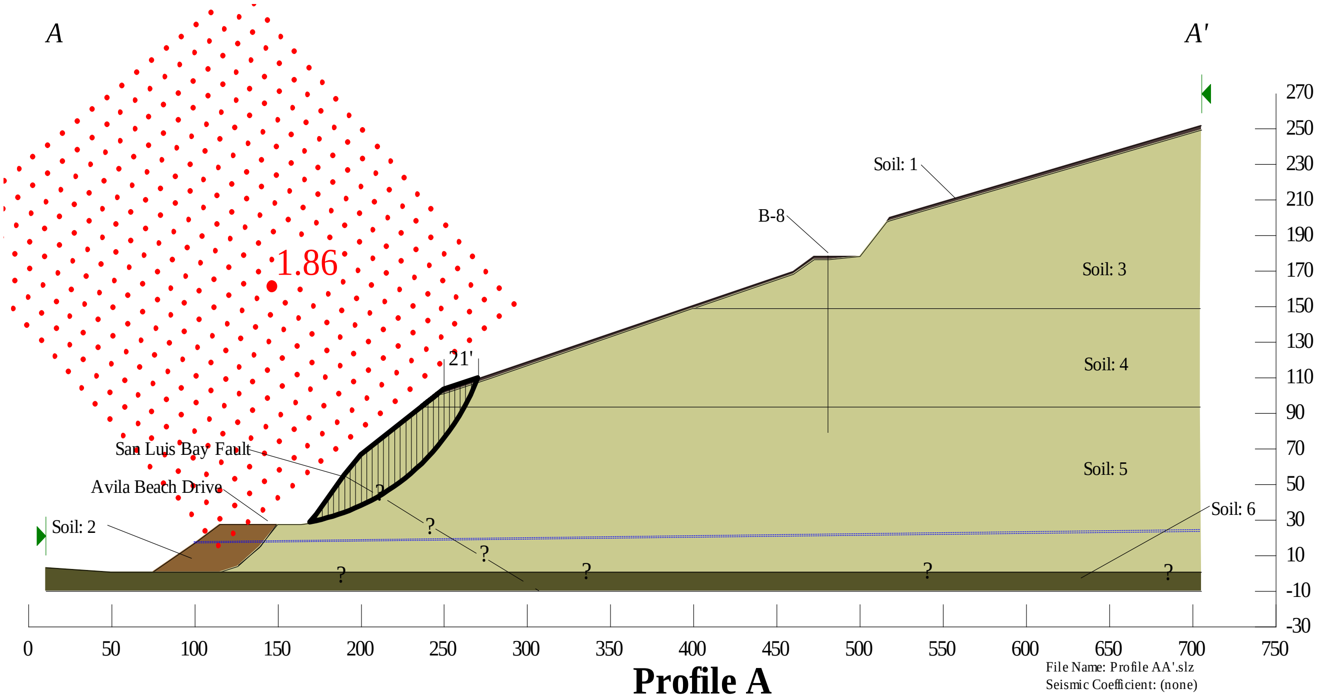


Figure CA-1A: Profile A-A' (Static Analysis)

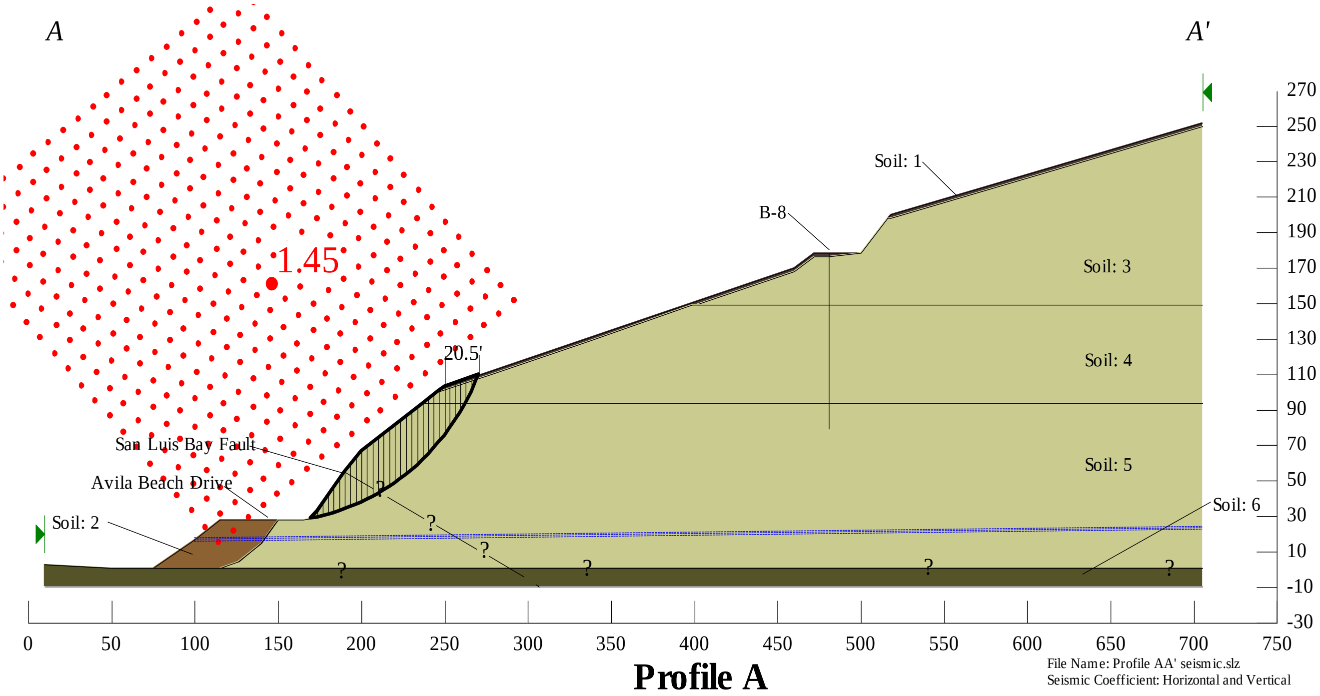


Figure C-1B: Profile A-A' (Seismic Analysis)

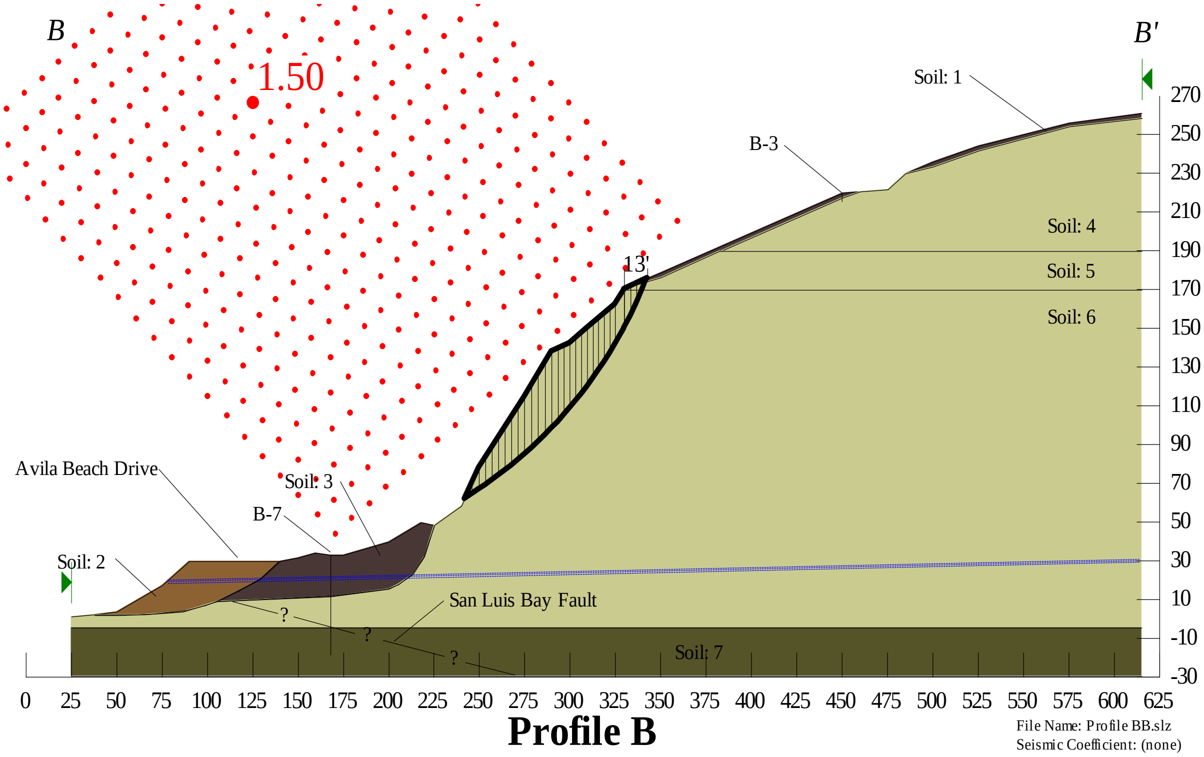


Figure C-2A: B-B' (Static Analysis)

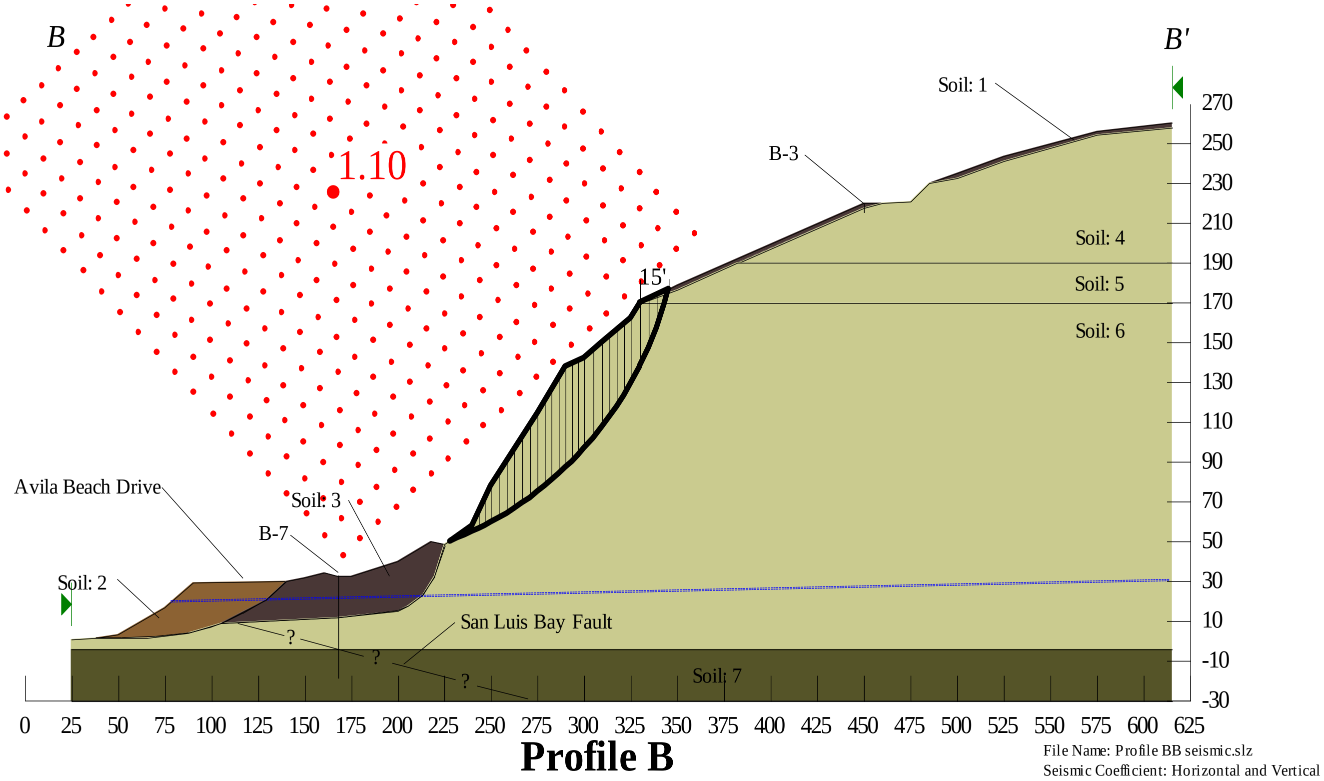


Figure C-2B: B-B' (Seismic Analysis)

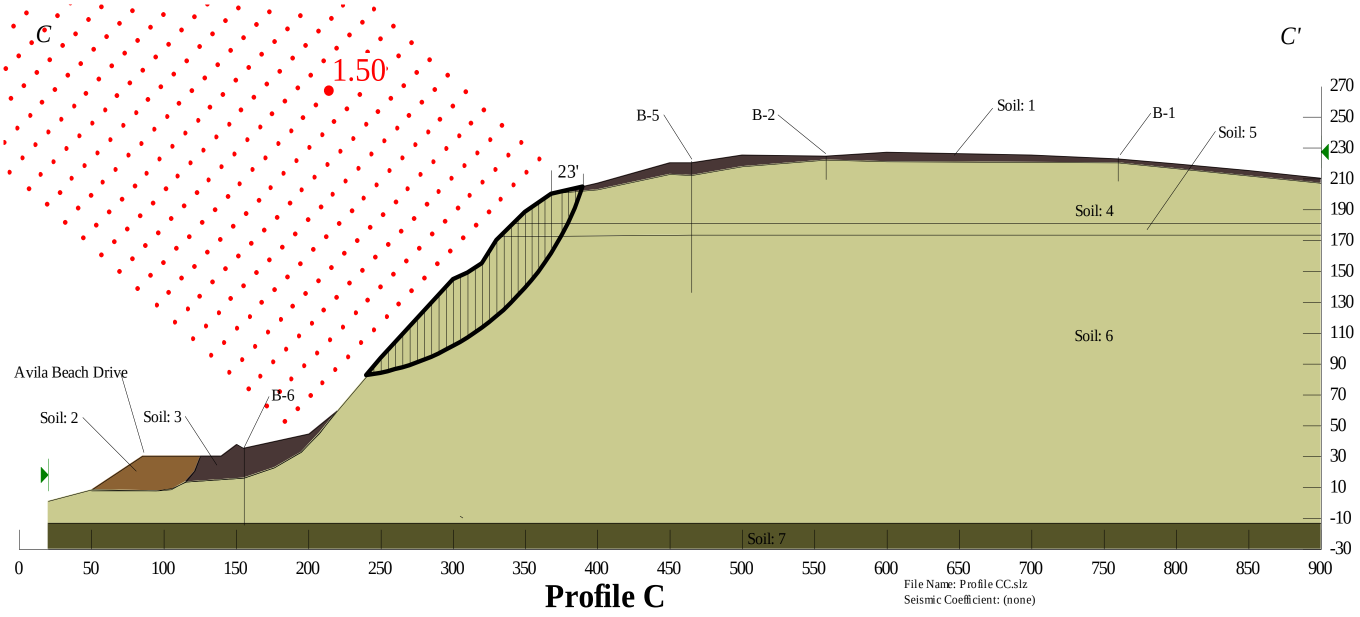


Figure C-3A: C-C’ (Static Analysis)

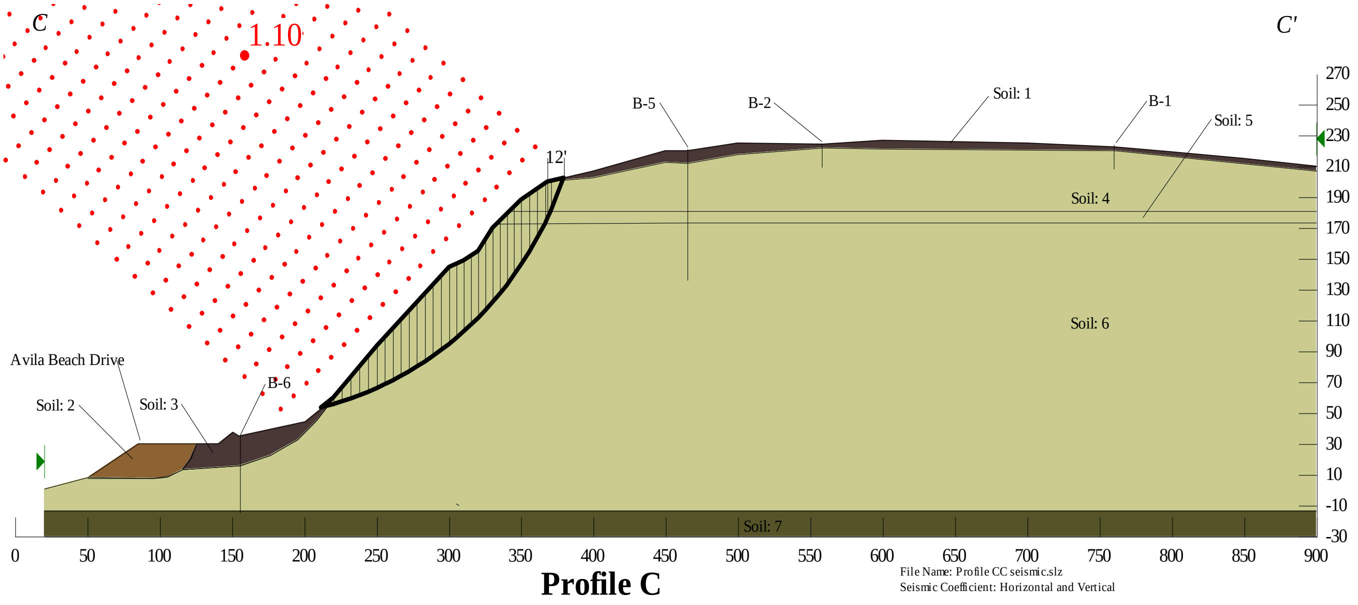


Figure C-3B: C-C’ (Seismic Analysis)

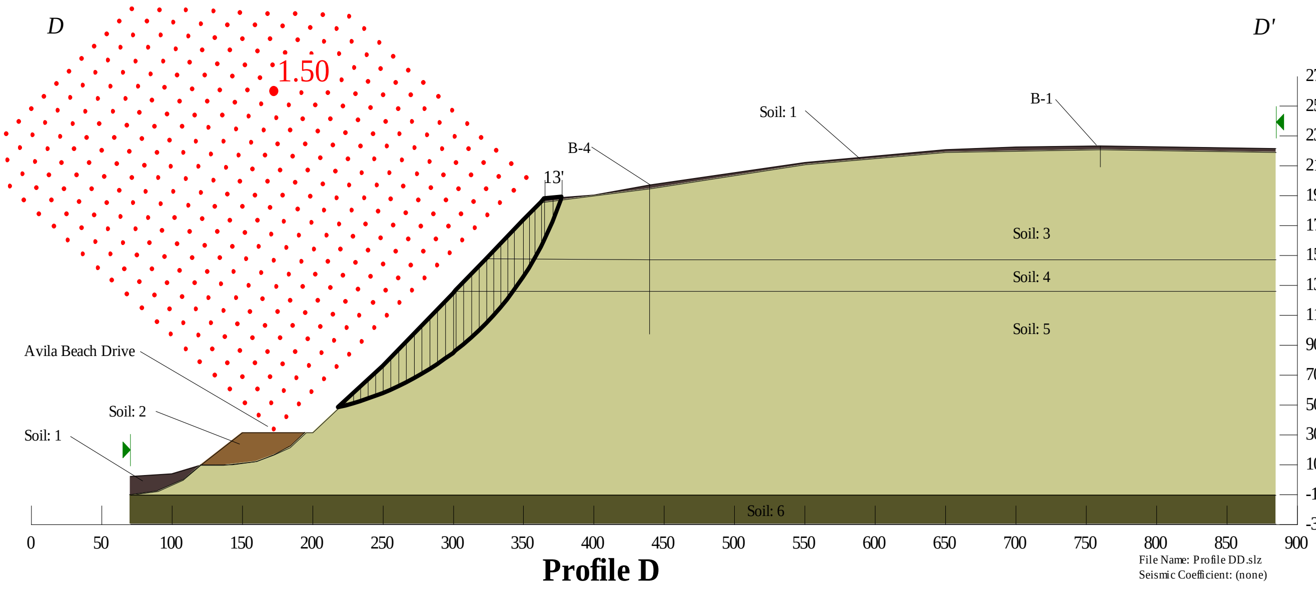


Figure C-4A: D-D' (Static Analysis)

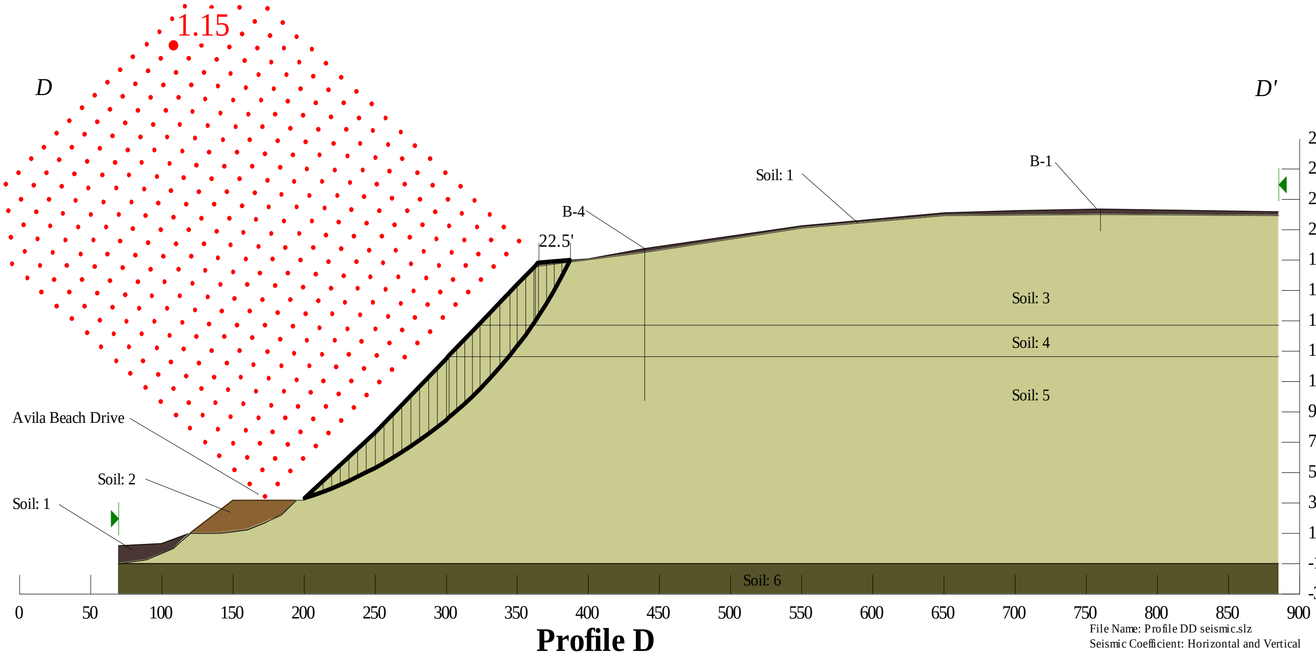


Figure C-4B: D-D' (Seismic Analysis)

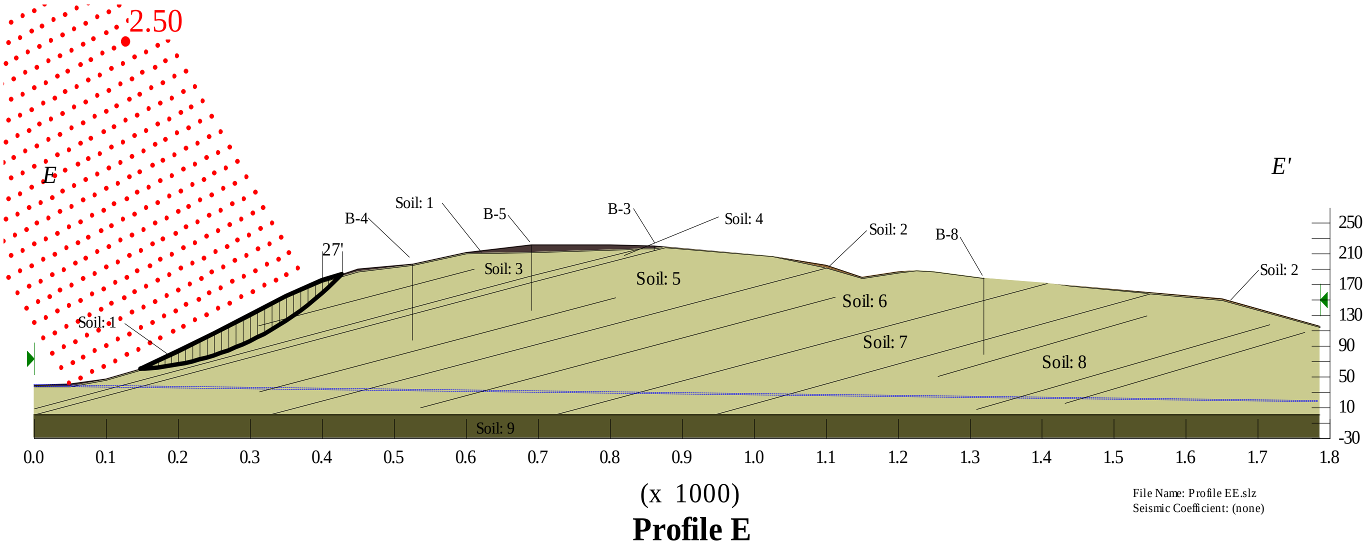


Figure C-5A: E-E’ (Static Analysis)

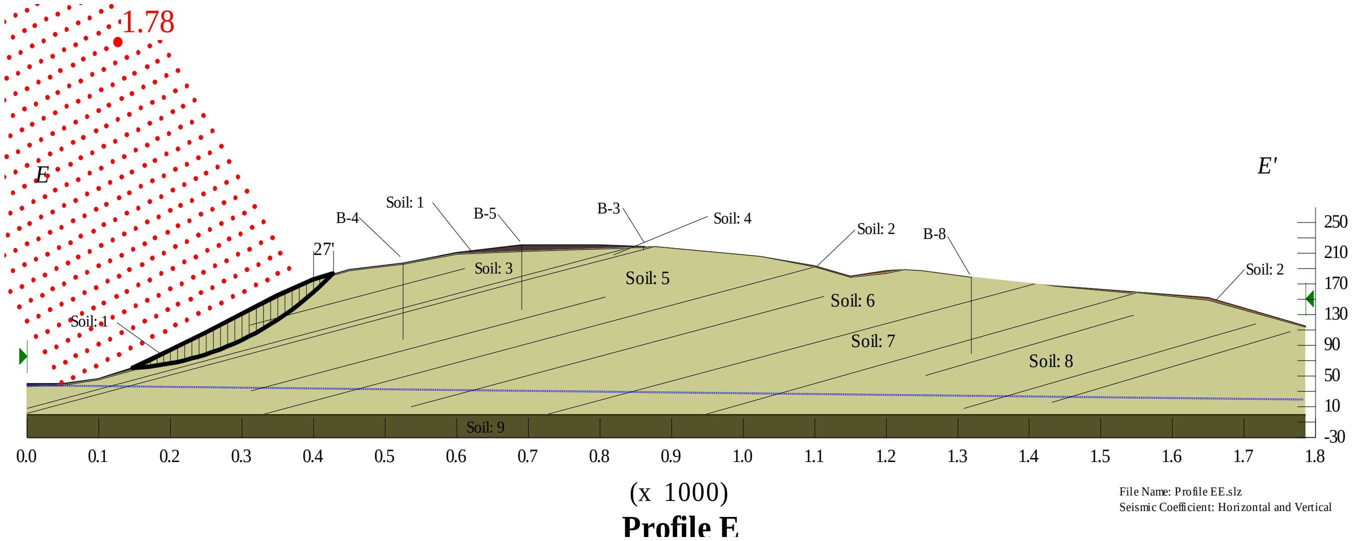


Figure C-5B: E-E’ (Seismic Analysis)

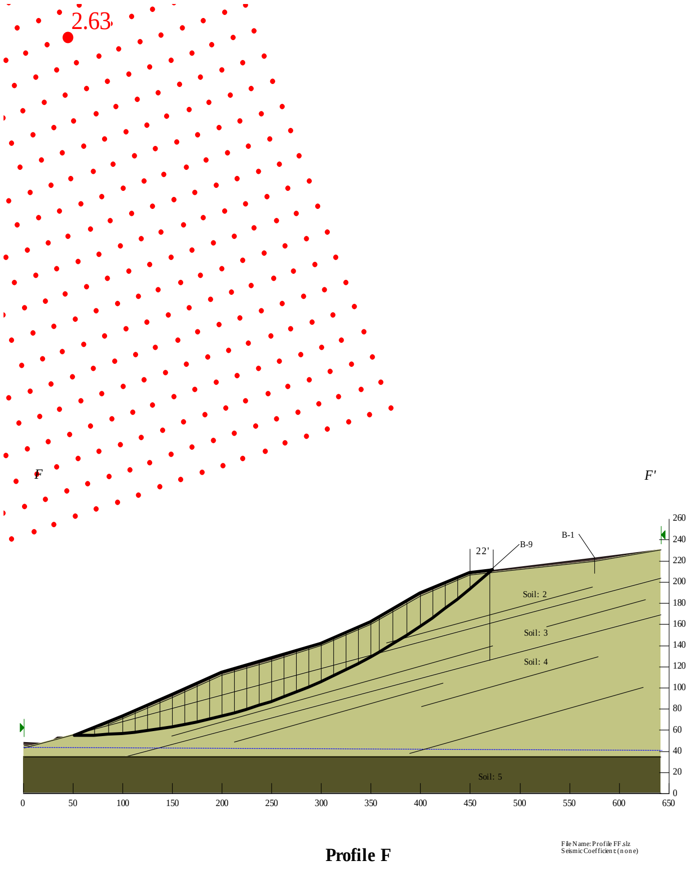


Figure C-6A: F-F' (Static Analysis)

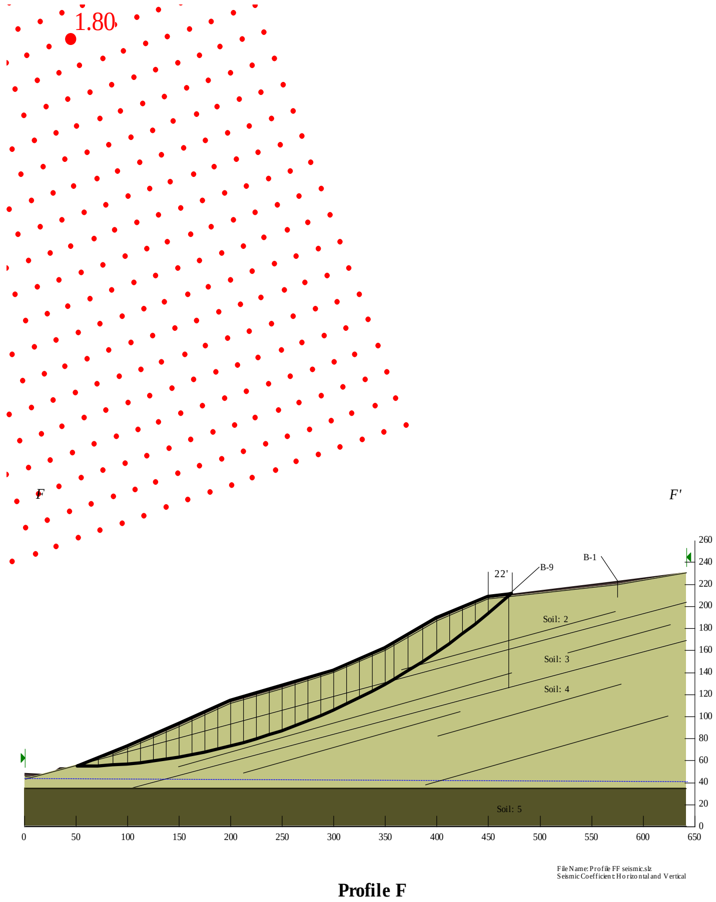


Figure C-6B: F-F' (Seismic Analysis)

C-4 Additional Numerical Analysis

An additional analysis was performed for this report along Section G-G' to verify the stability of the current bluff. As discussed in Section 1, a section of the bluff was graded in 2011 including the removal of material at the top of the slope and placement of fill at the base of the slope. The profile was determined from the current topographic map as presented on Plate 1. Laboratory results from Section C-2 was utilized in the analysis. The factor of safety values for Profile G (static and pseudo-static) are greater than the 1.5 and 1.1. The global stability of the bluff is observed to be stable at the current configuration, however if surface water is left uncontrolled surficial instability and erosion can occur. Figure C-7A and C-7B present the results of the slope stability analysis on Profile G.

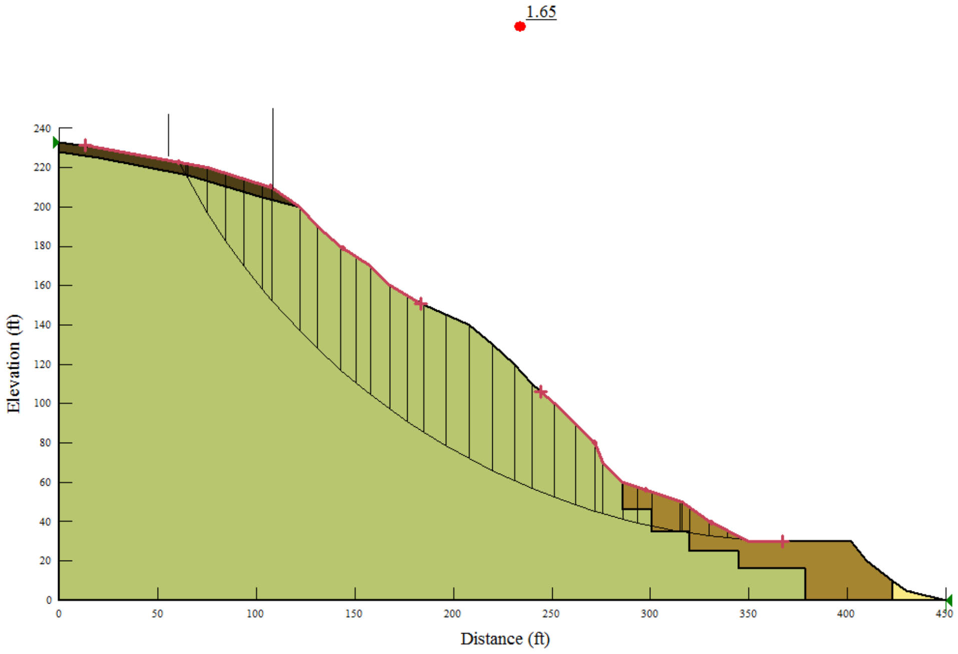


Figure C-7A: G-G’ (Static Analysis)

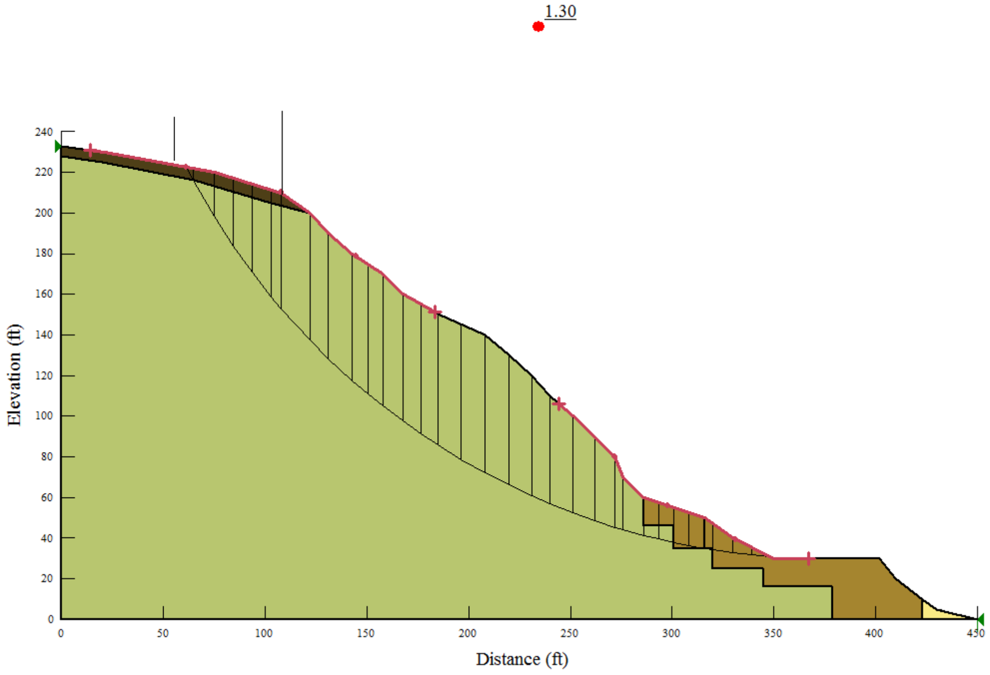


Figure C-7B: G-G’ (Psuedo-Static Analysis)

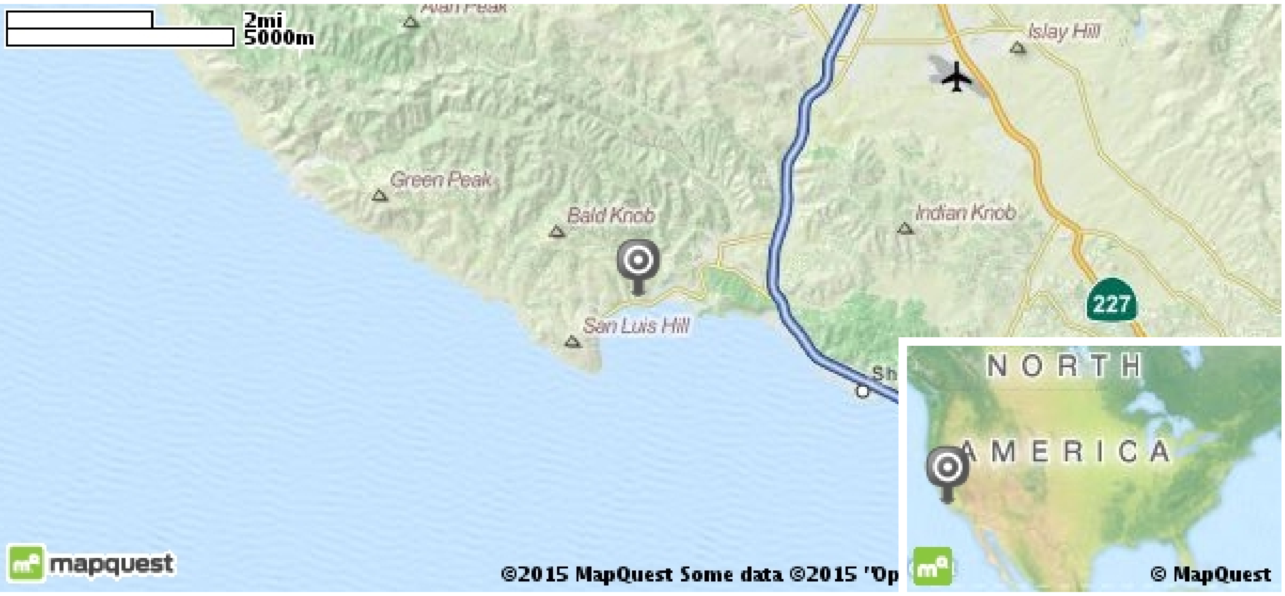
APPENDIX C

USGS Design Maps Summary and Detailed Report

USGS Design Maps Summary Report

User–Specified Input

Report Title	Seaside Garden Cottages Mon November 2, 2015 17:56:36 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	35.1797°N, 120.744°W
Site Soil Classification	Site Class C – "Very Dense Soil and Soft Rock"
Risk Category	I/II/III

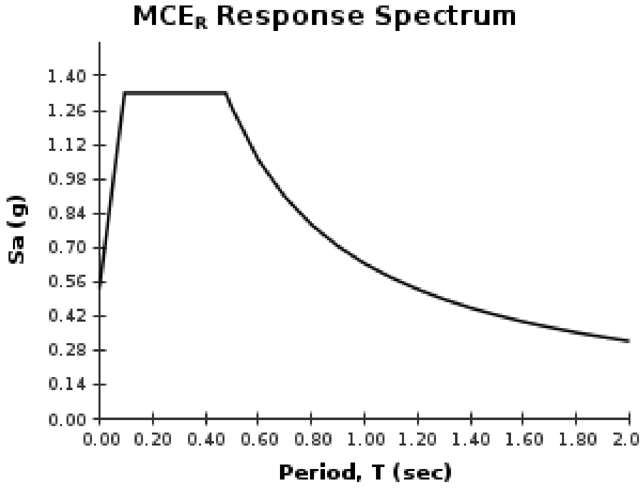


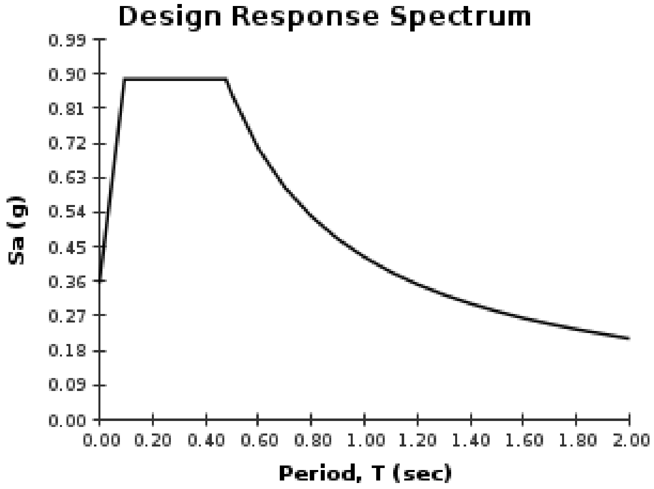
USGS–Provided Output

S_S = 1.330 g **S_{MS} =** 1.330 g **S_{DS} =** 0.886 g

S_1 = 0.481 g **S_{M1} =** 0.634 g **S_{D1} =** 0.423 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (35.1797°N, 120.744°W)

Site Class C – "Very Dense Soil and Soft Rock", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1]	S_S = 1.330 g
From Figure 22-2 [2]	S_1 = 0.481 g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class C, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index *PI* > 20, • Moisture content *w* ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = C and S_s = 1.330 g, F_a = 1.000

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = C and S_1 = 0.481 g, F_v = 1.319

Equation (11.4–1): $S_{MS} = F_aS_S = 1.000 \times 1.330 = 1.330$ g

Equation (11.4–2): $S_{M1} = F_vS_1 = 1.319 \times 0.481 = 0.634$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

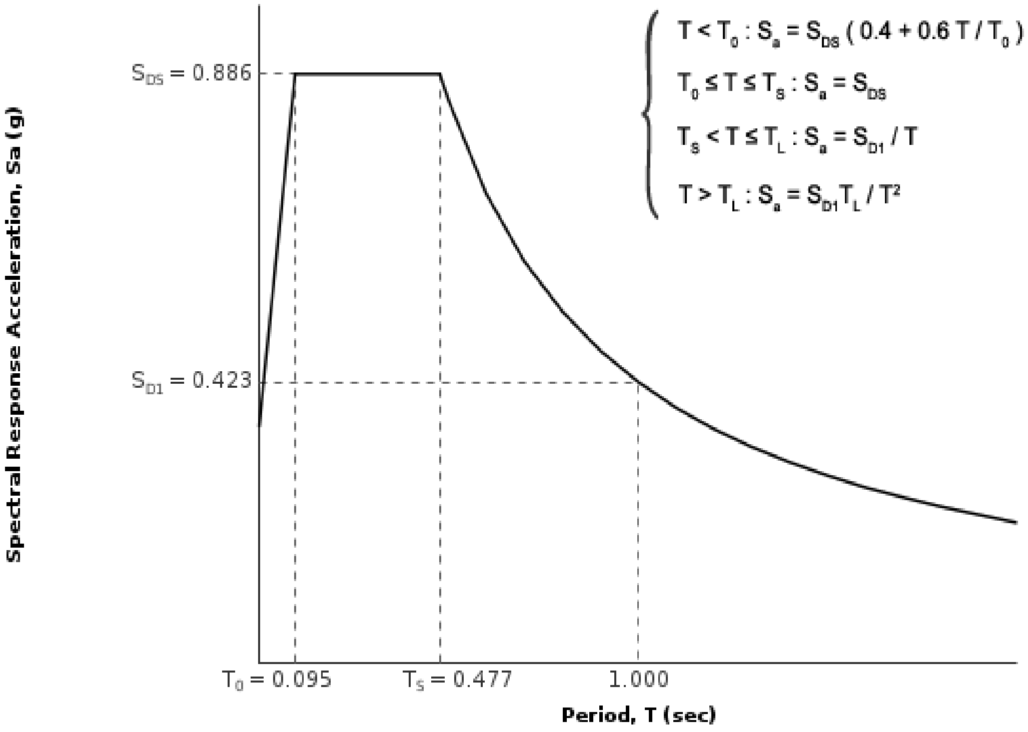
Equation (11.4–3): $S_{DS} = ⅔ S_{MS} = ⅔ \times 1.330 = 0.886$ g

Equation (11.4–4): $S_{D1} = ⅔ S_{M1} = ⅔ \times 0.634 = 0.423$ g

Section 11.4.5 — Design Response Spectrum

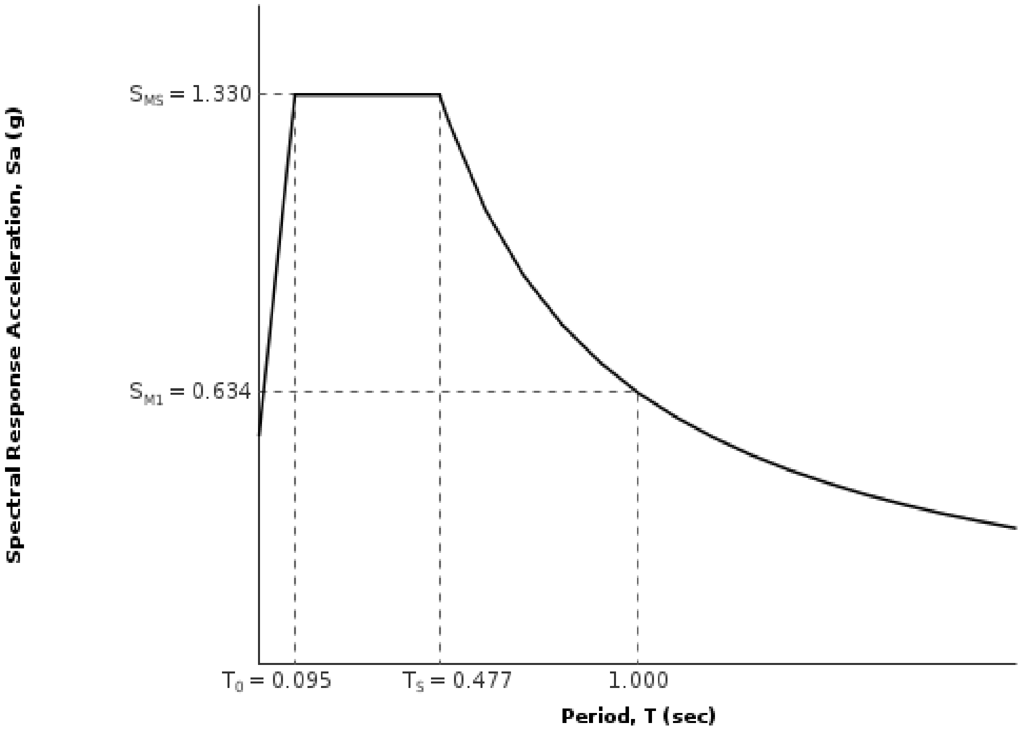
From Figure 22-12 [3] $T_L = 8$ seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE$_R$) Response Spectrum

The MCE$_R$ Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.564

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.564 = 0.564$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	$\boxed{1.0}$
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = C and PGA = 0.564 g, F_{PGA} = 1.000

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] $C_{RS} = 0.874$

From Figure 22-18 [6] $C_{R1} = 0.917$

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	**RISK CATEGORY**		
	I or II	**III**	**IV**
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 0.886 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	**RISK CATEGORY**		
	I or II	**III**	**IV**
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.423 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ “the more severe design category in accordance with Table 11.6-1 or 11.6-2” = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf